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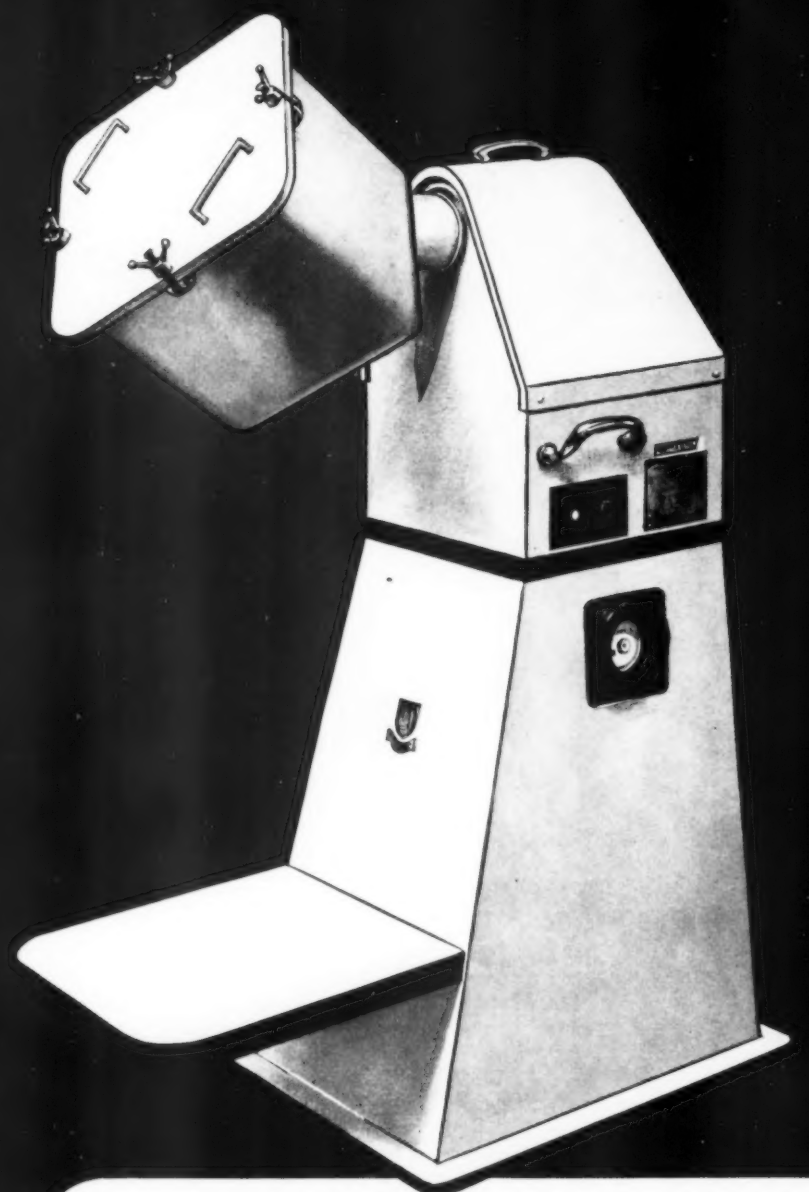

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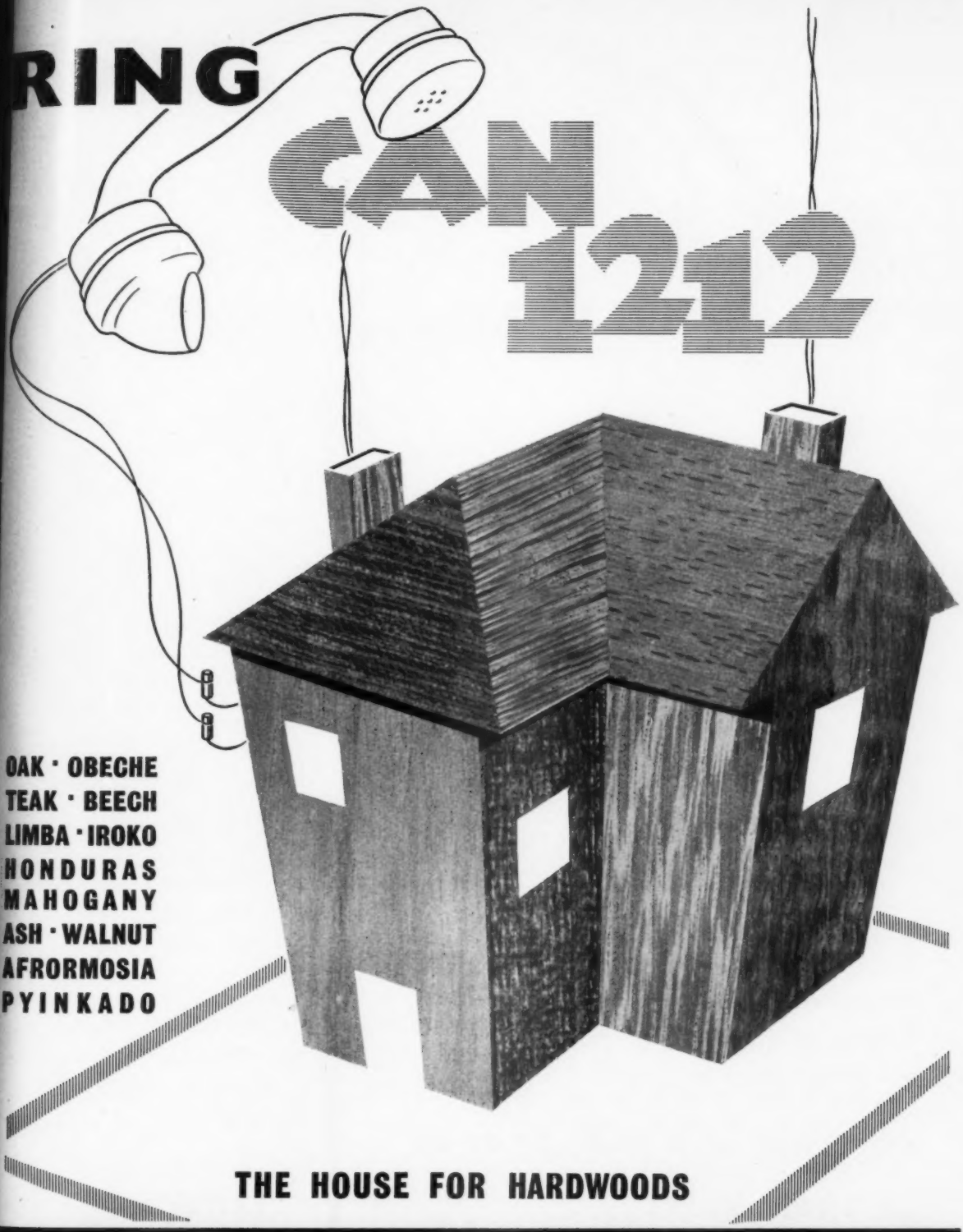

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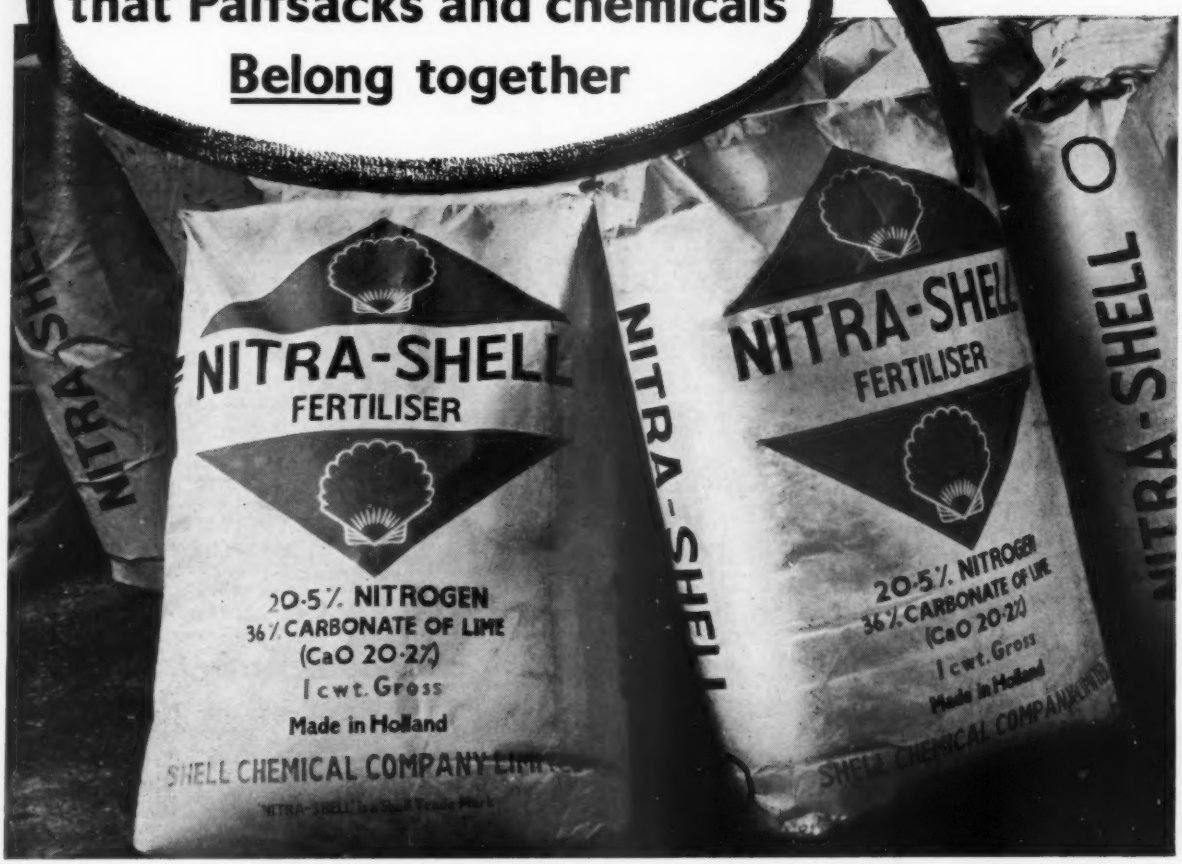

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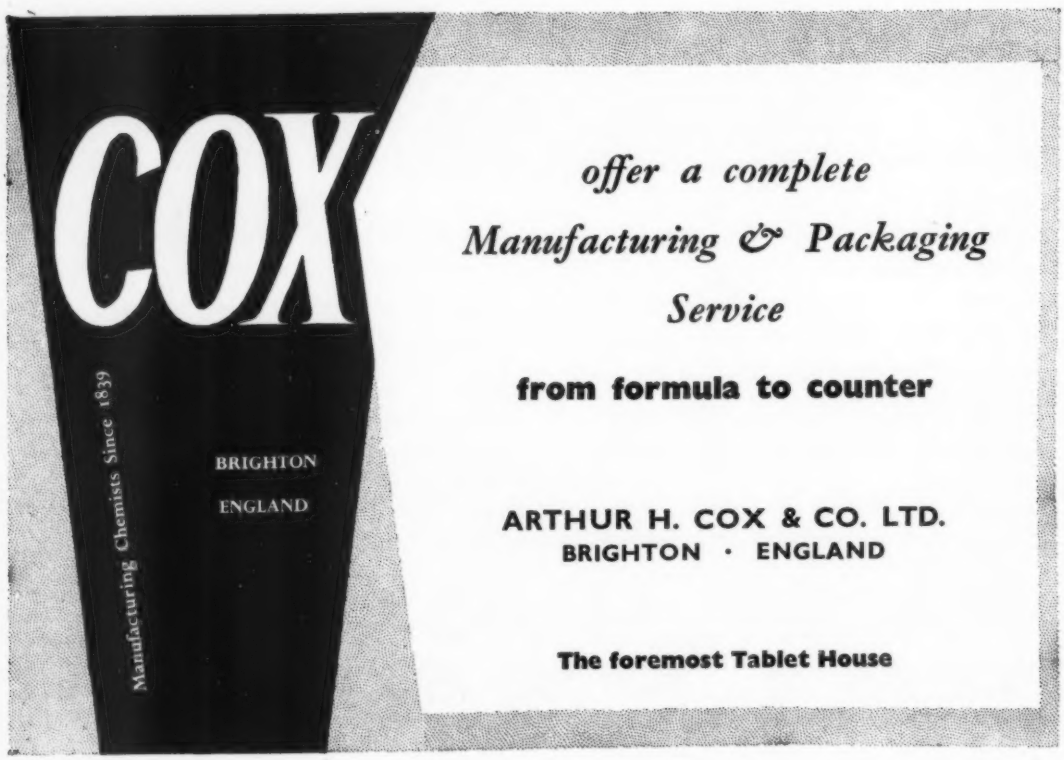

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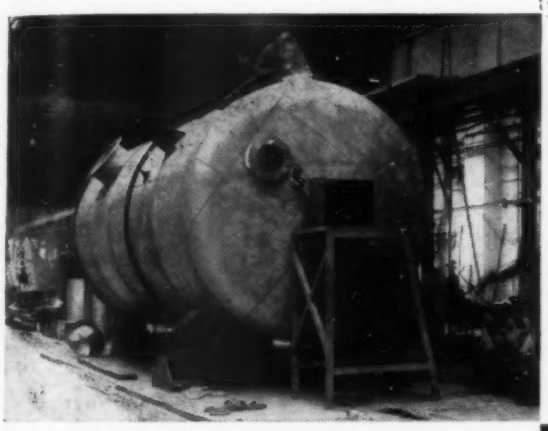
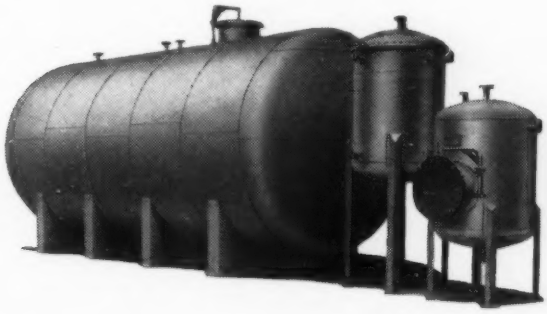


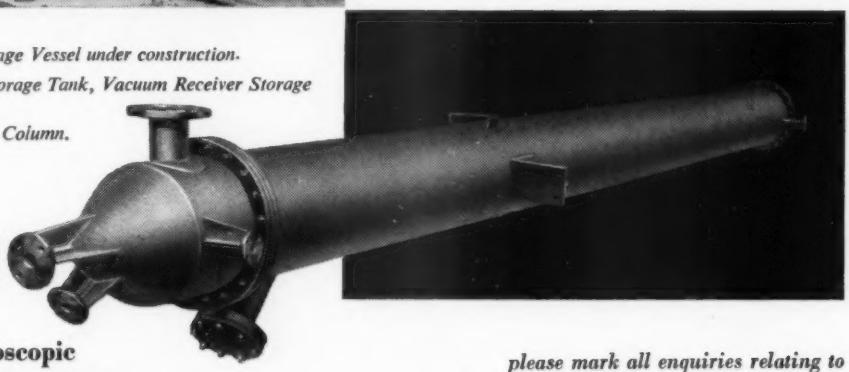


ILLUSTRATIONS

Above: A Polymer Storage Vessel under construction.

Top right: A Solvent Storage Tank, Vacuum Receiver Storage Tank, and Buffer Tank.

Lower right: A Reactor Column.



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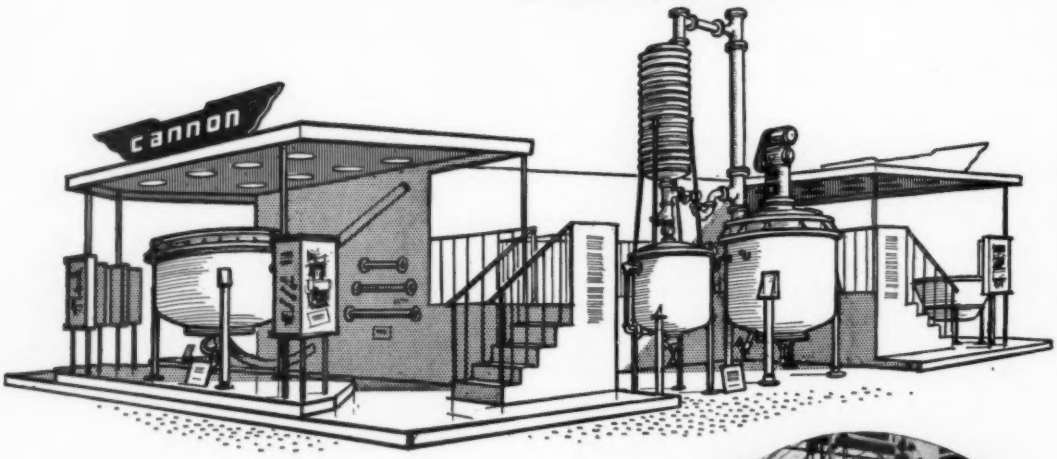

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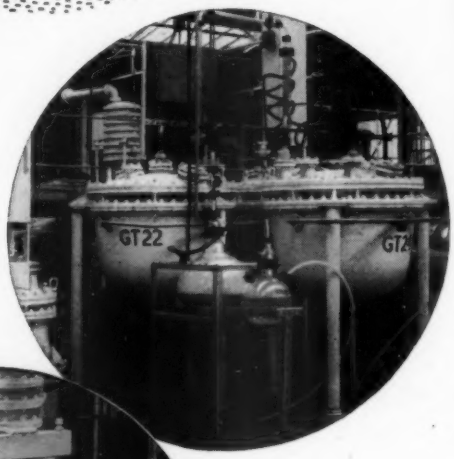

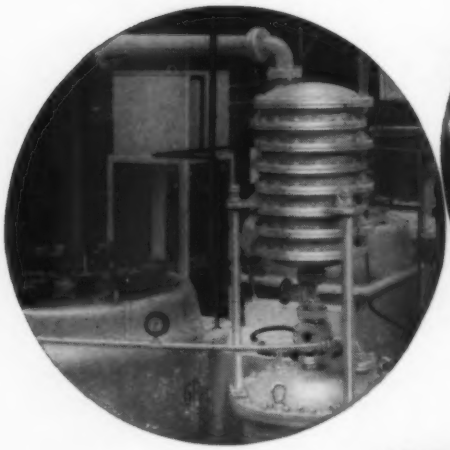

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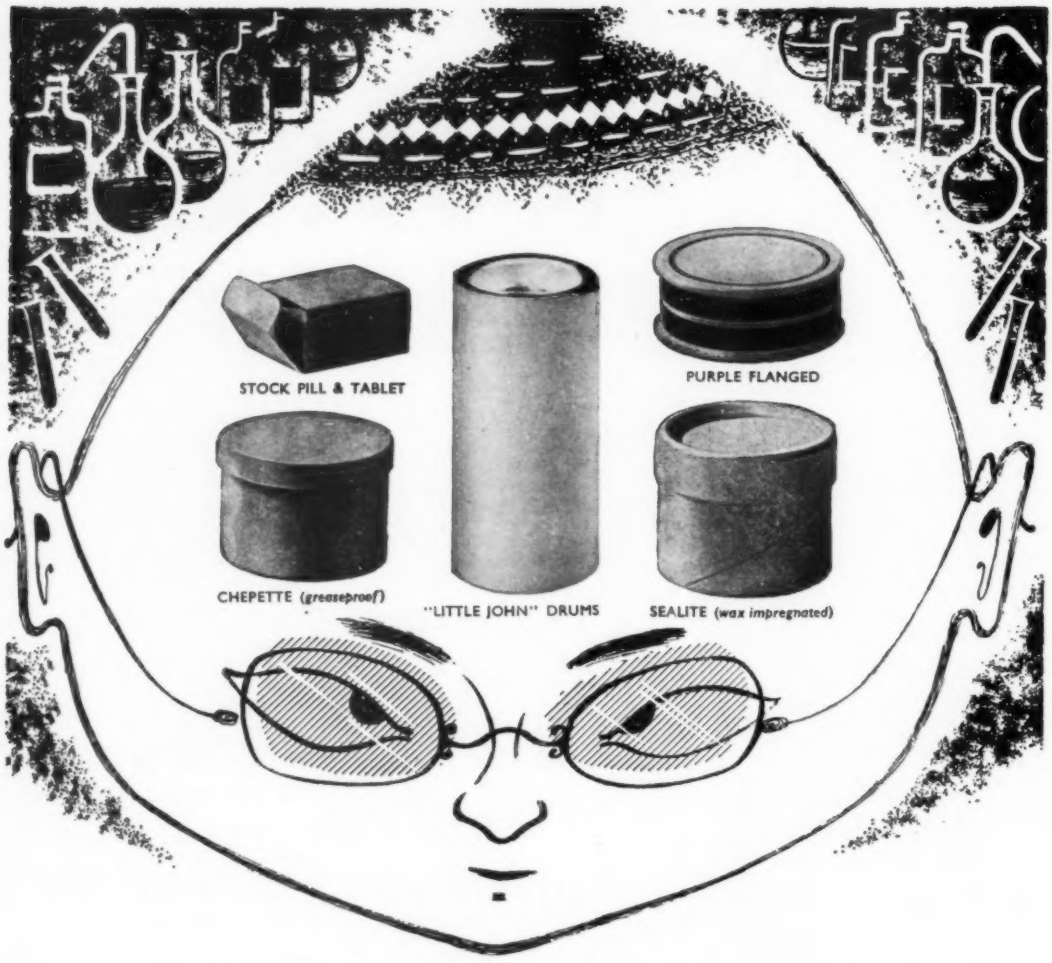

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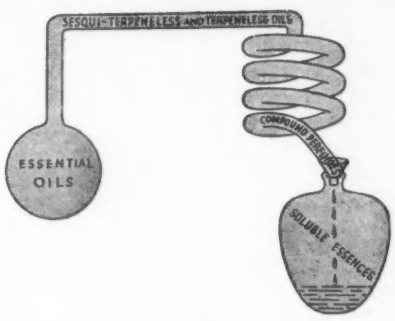

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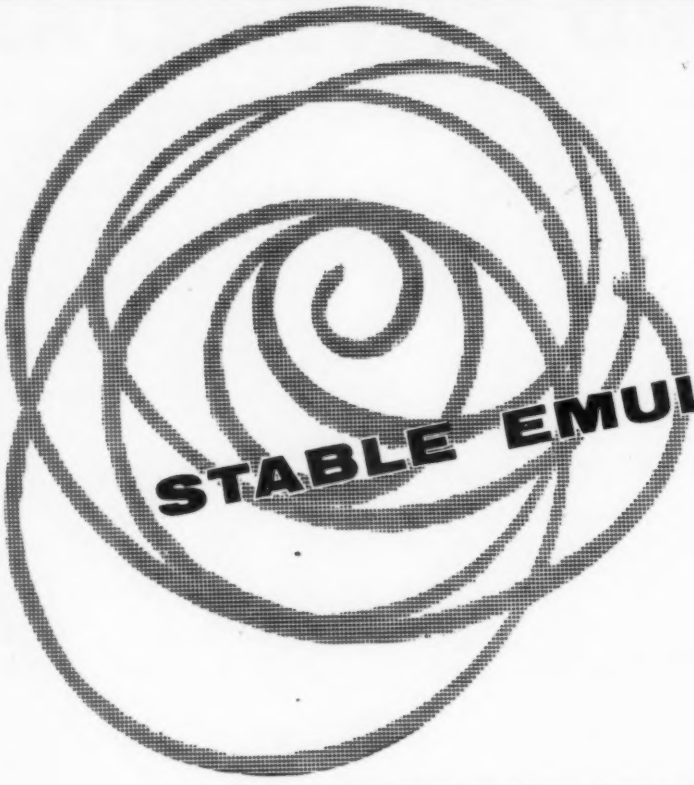

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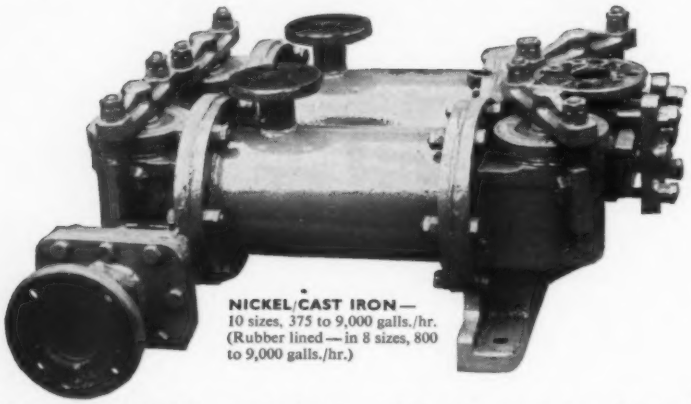

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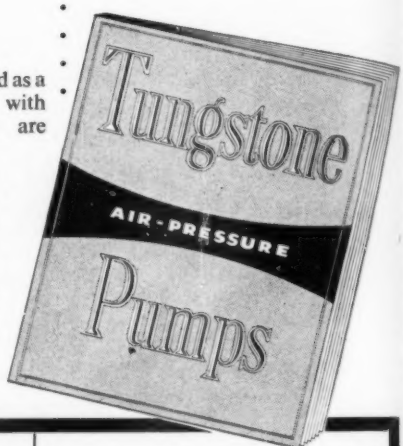

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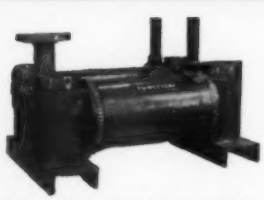

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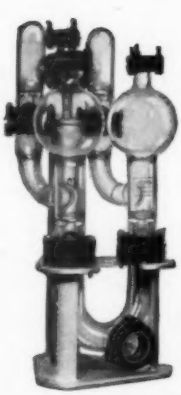

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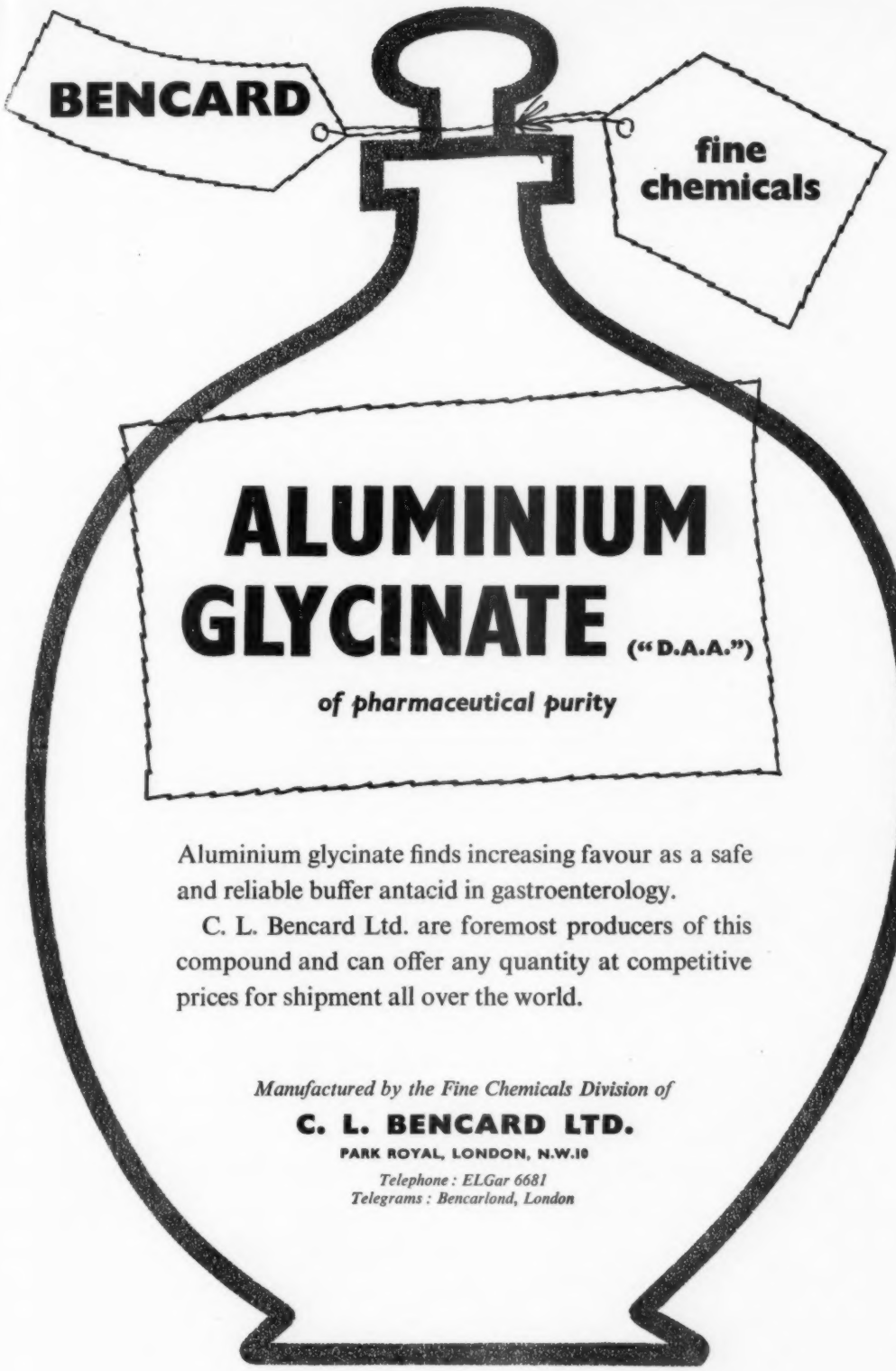

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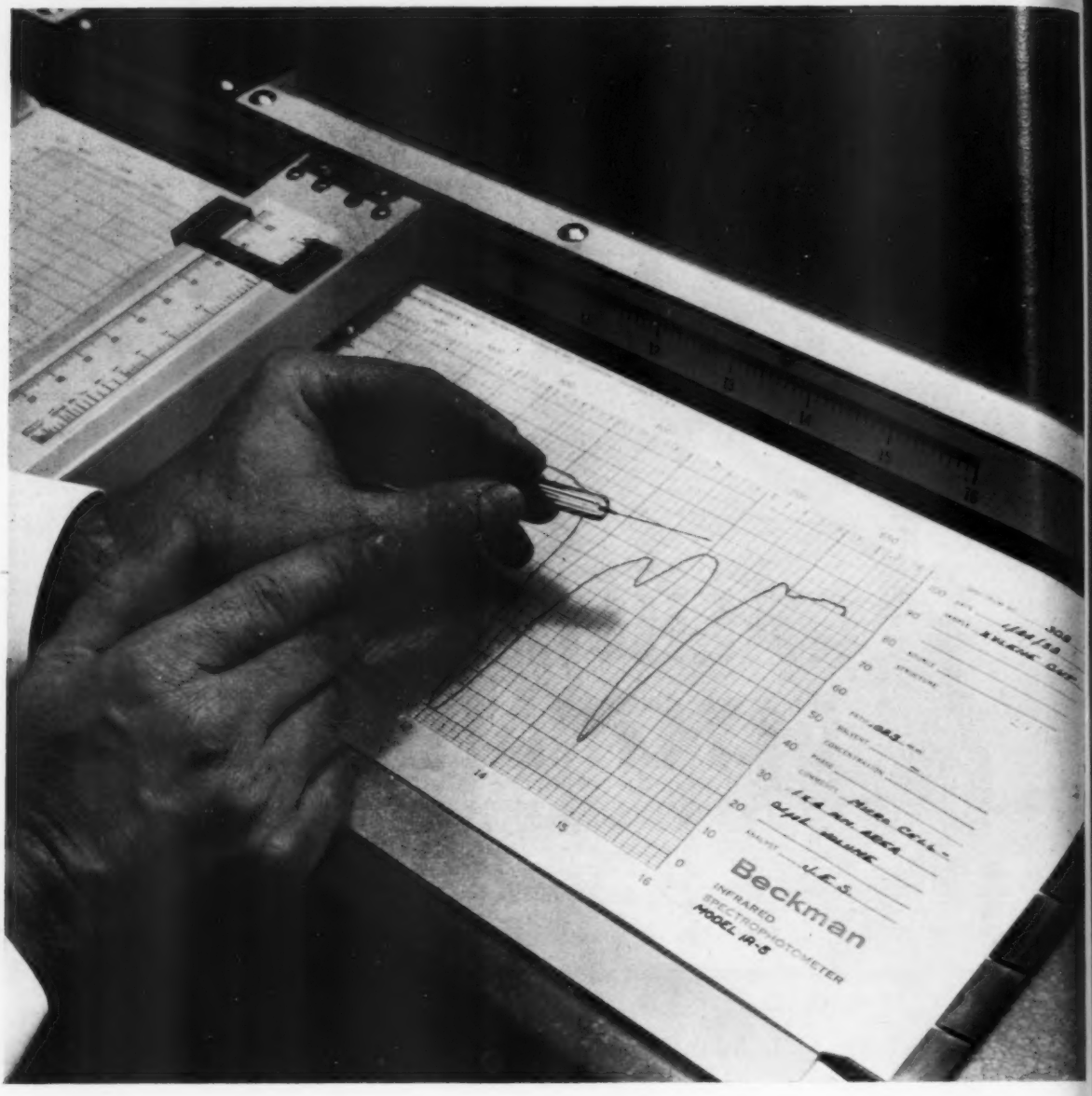

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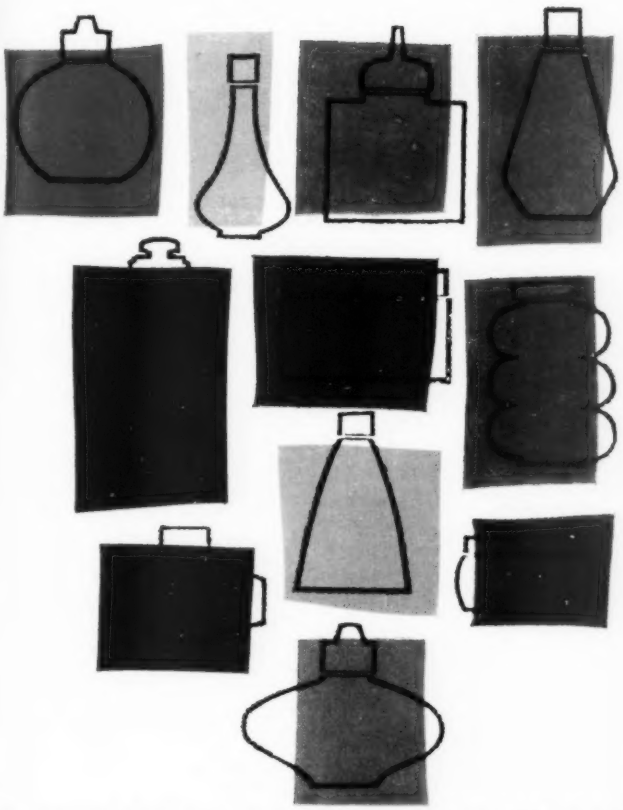

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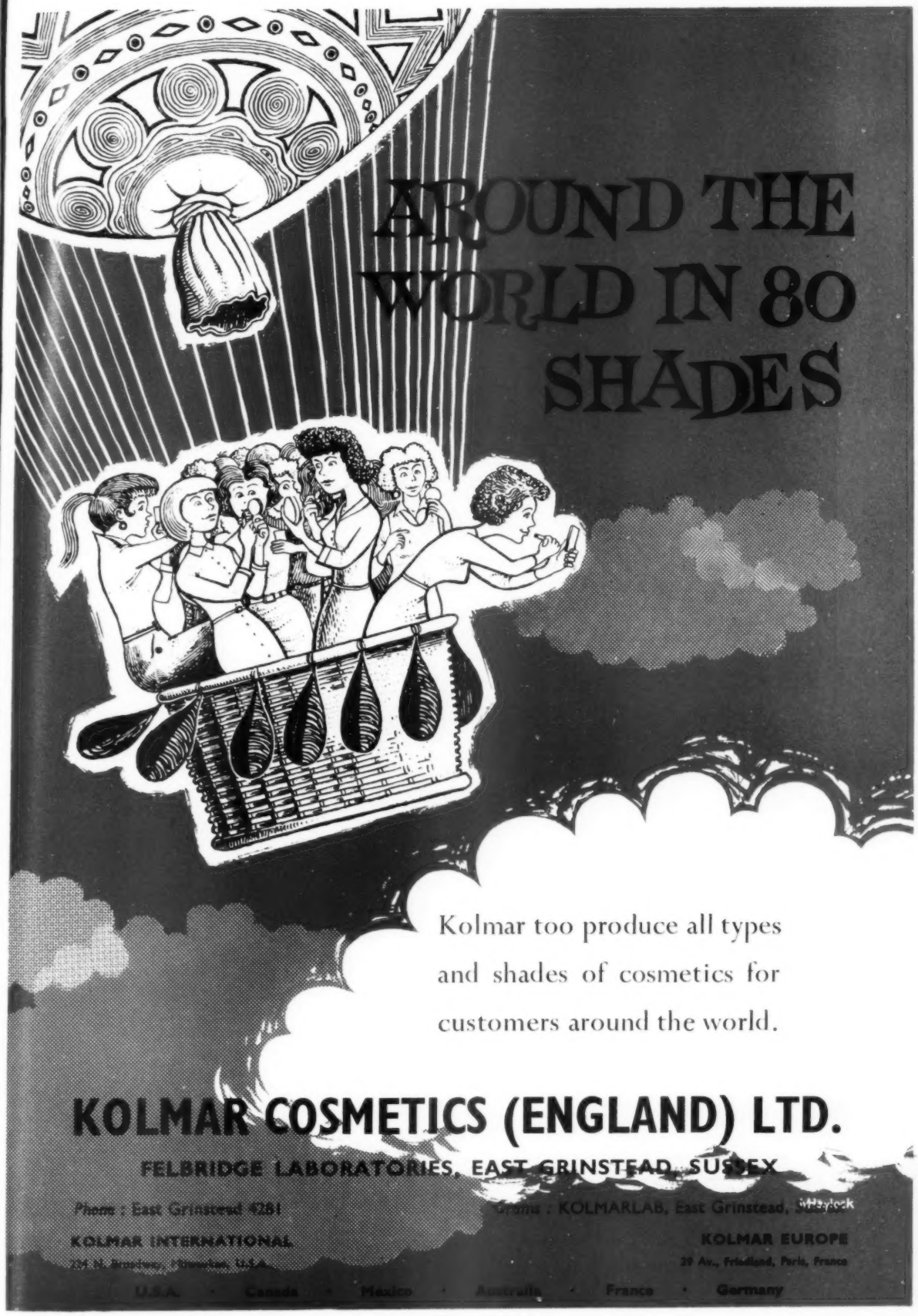
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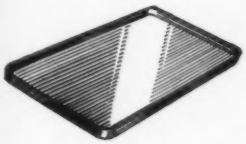

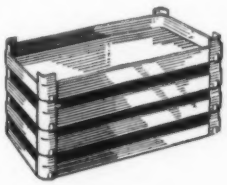

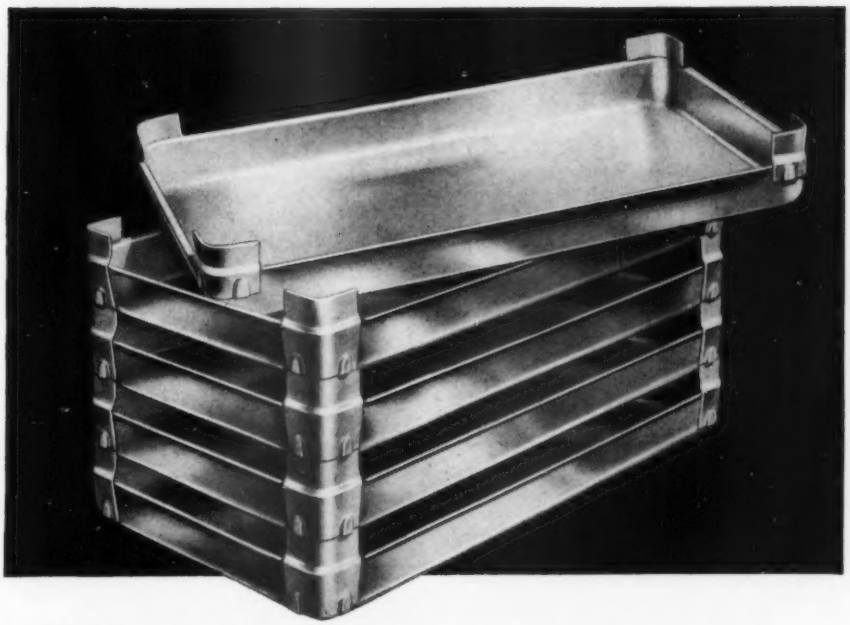

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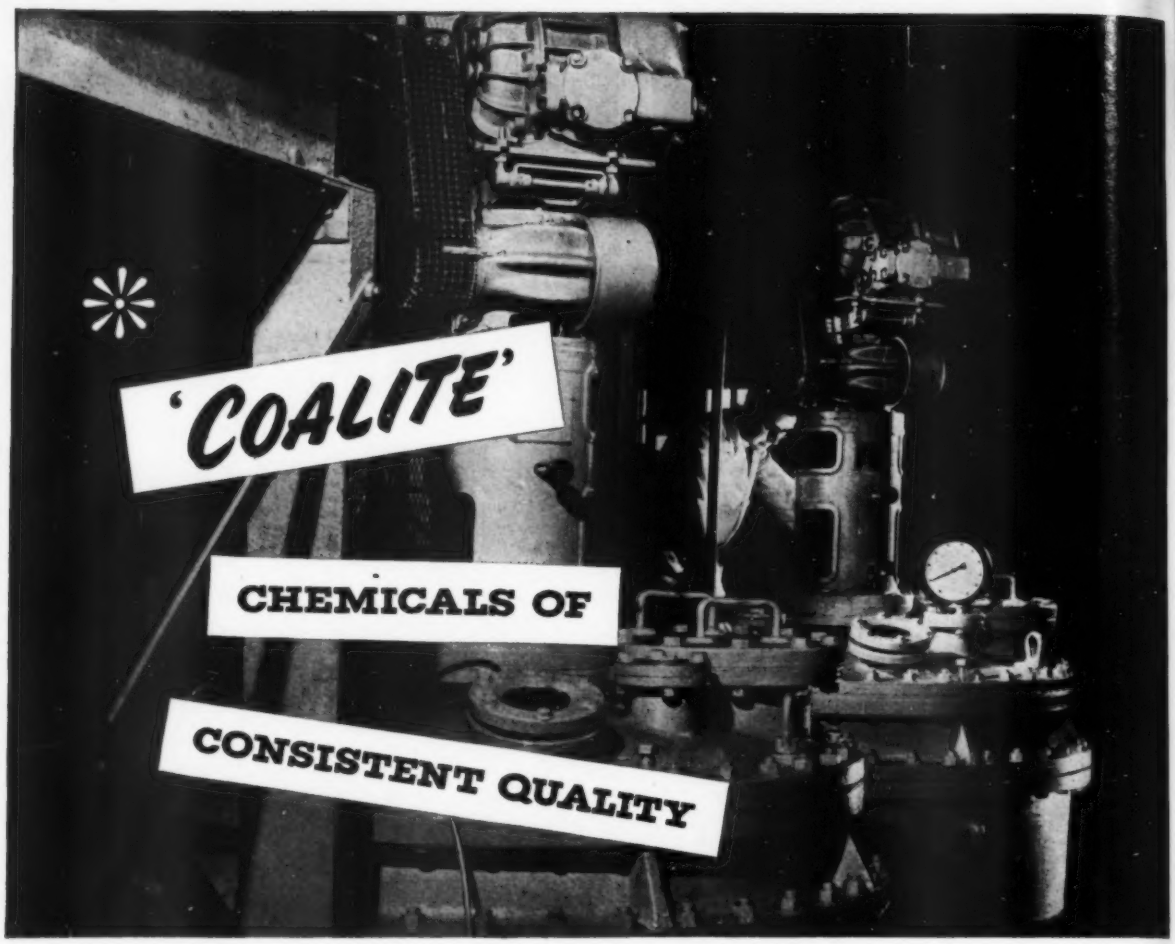

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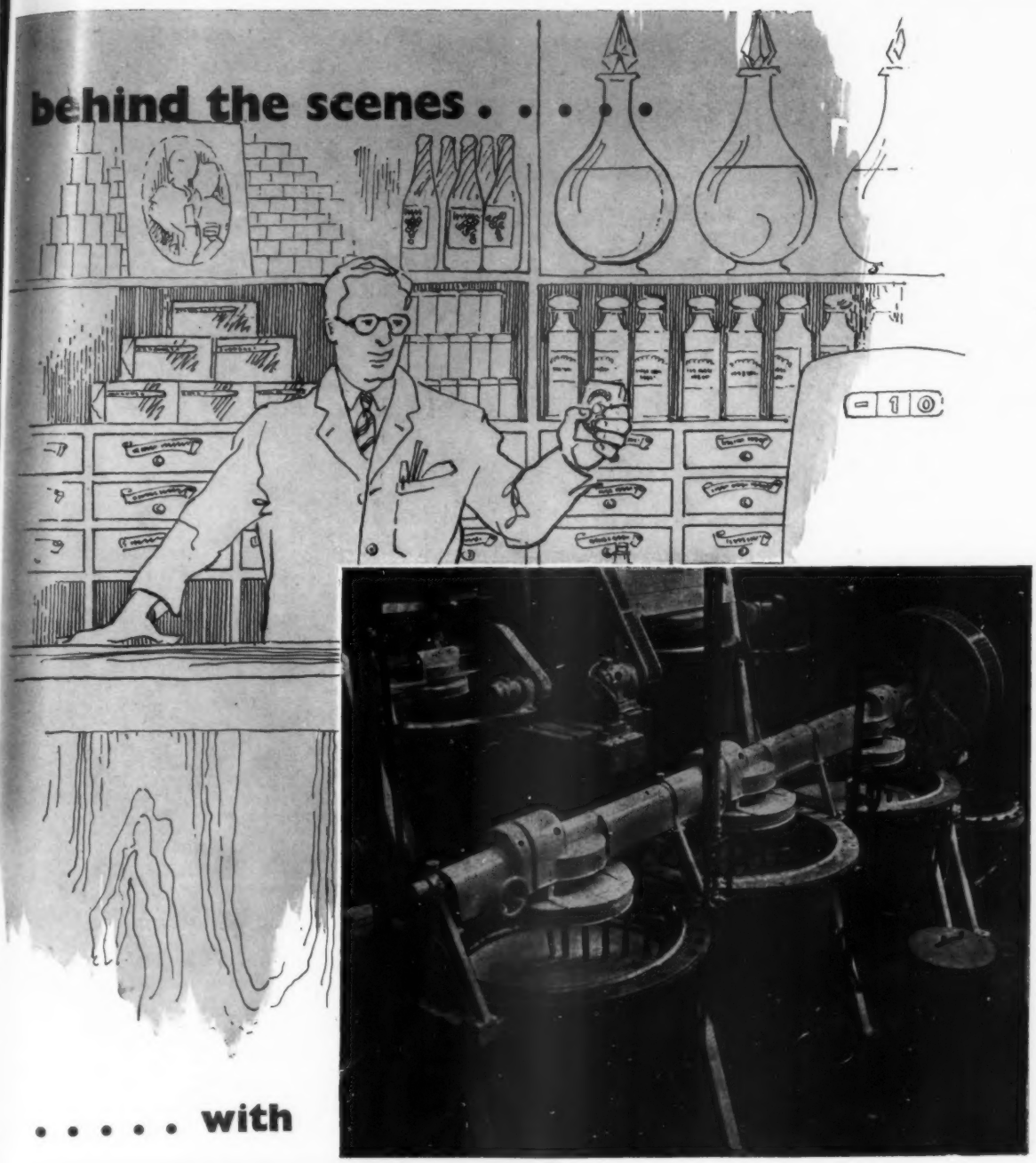

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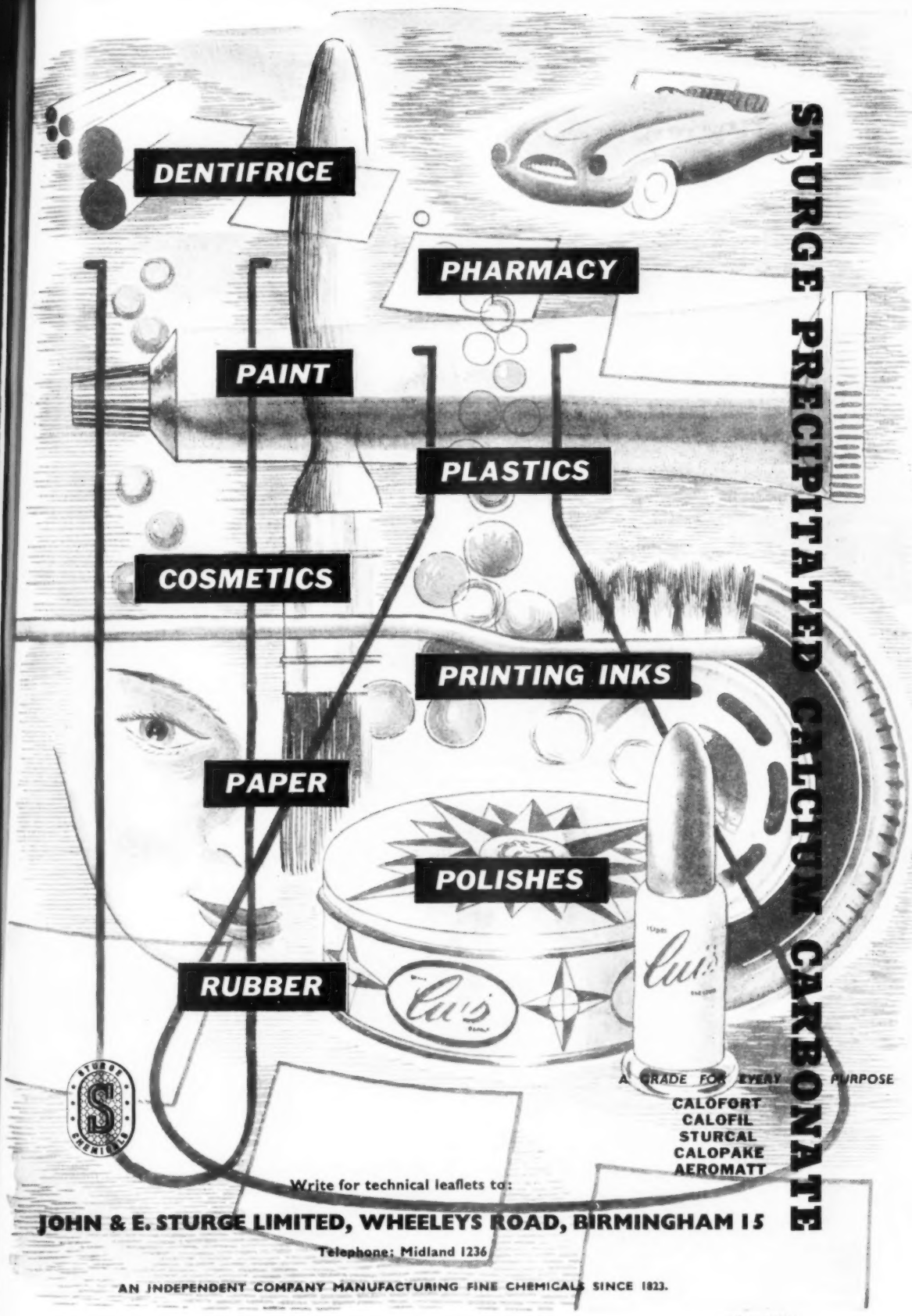
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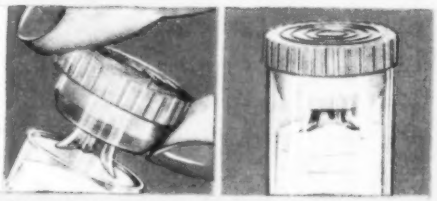

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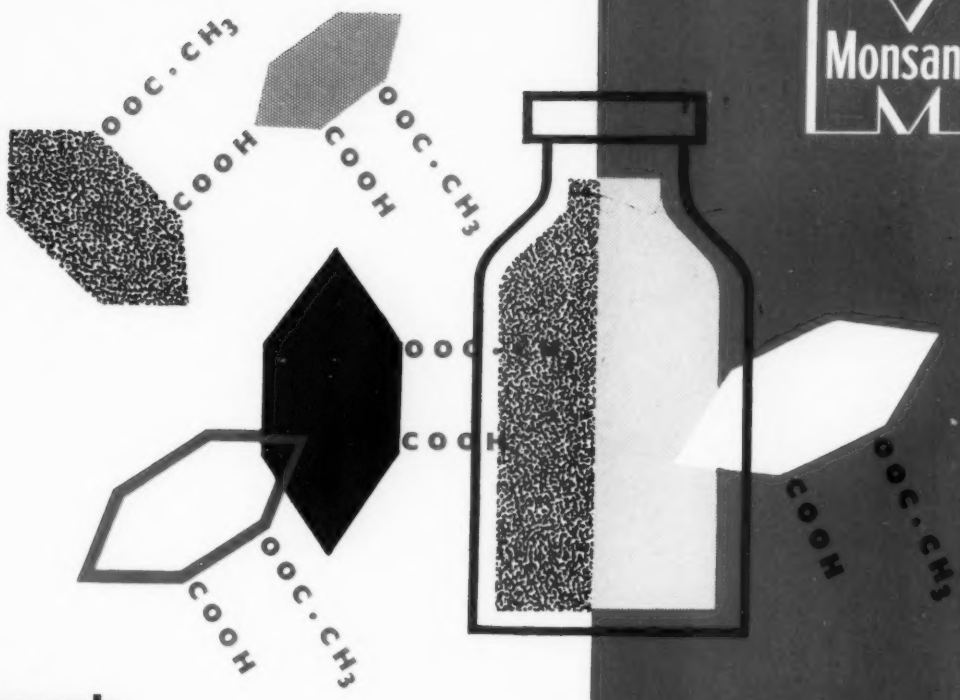

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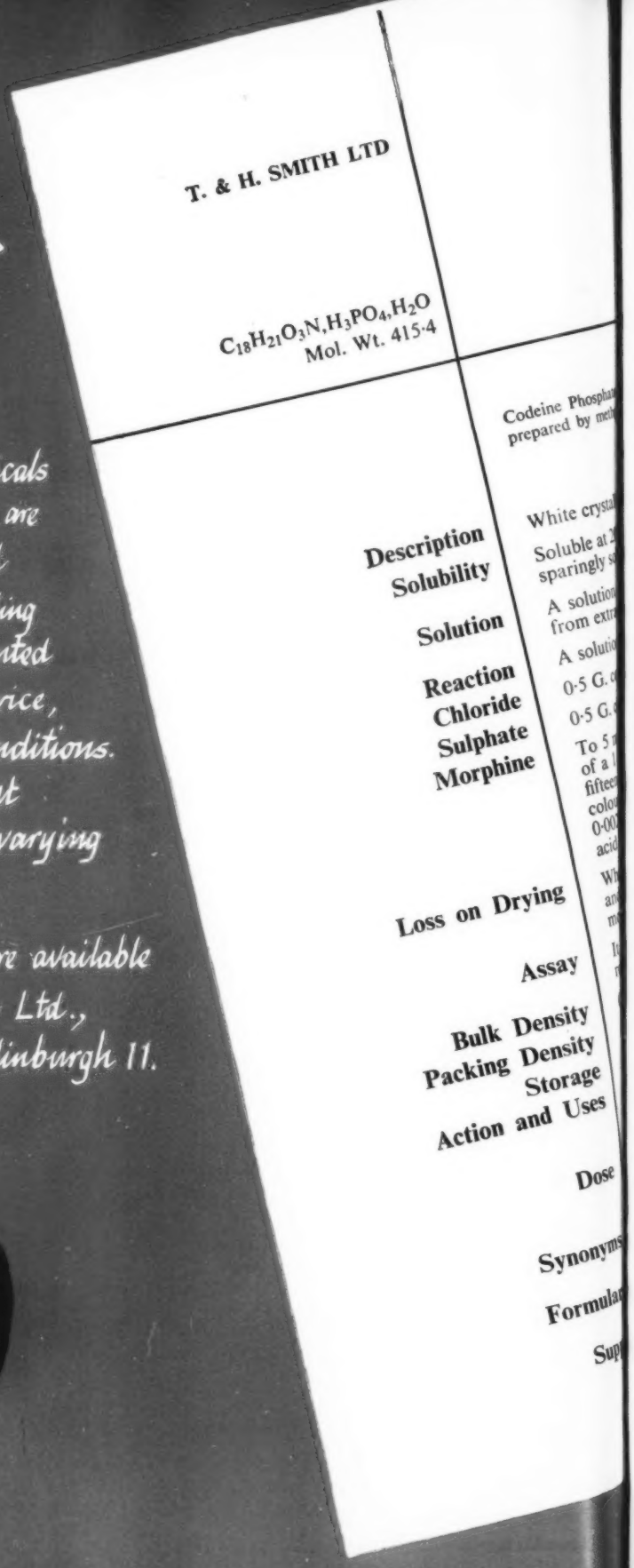

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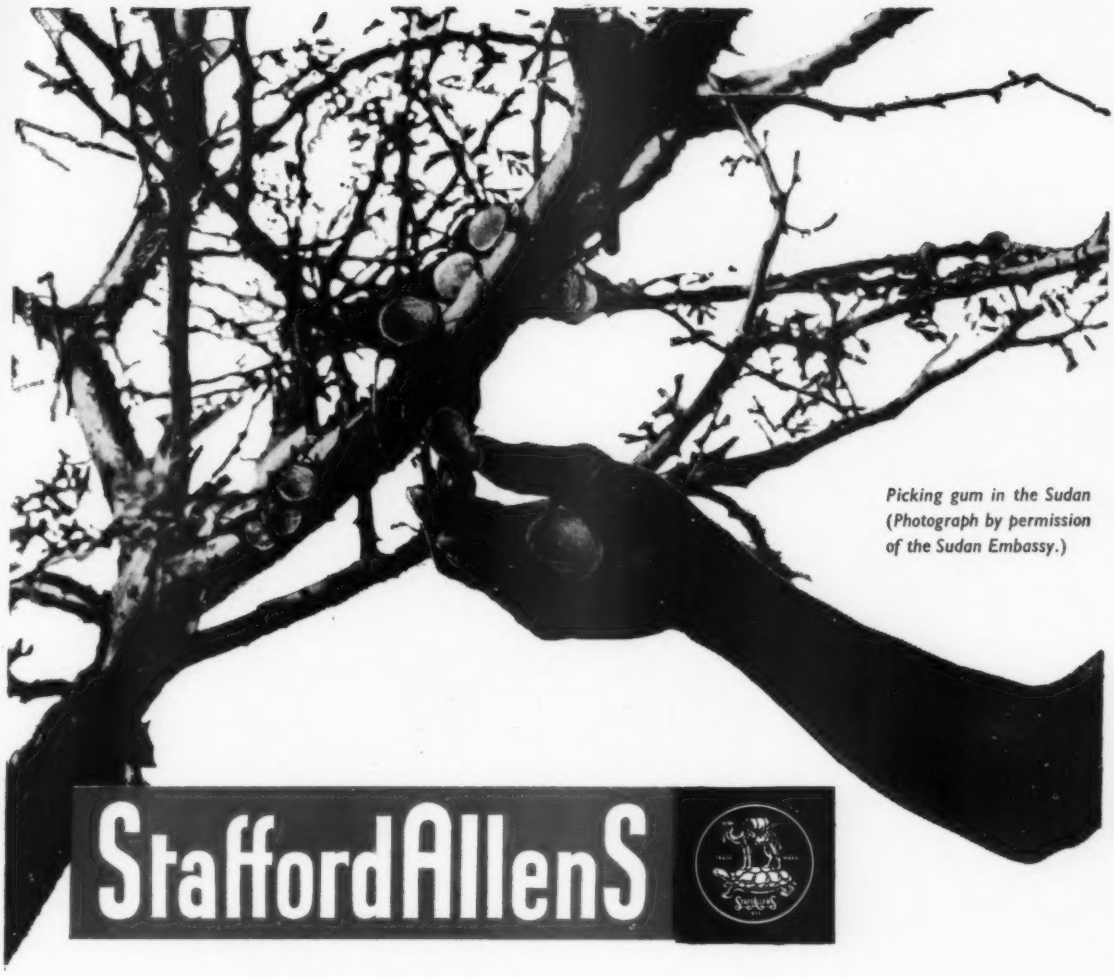

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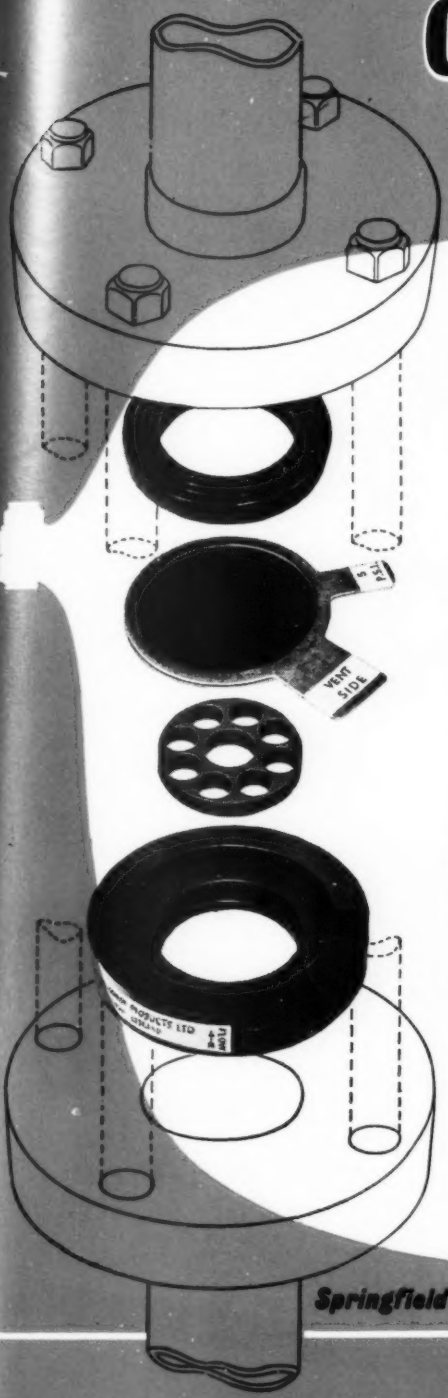

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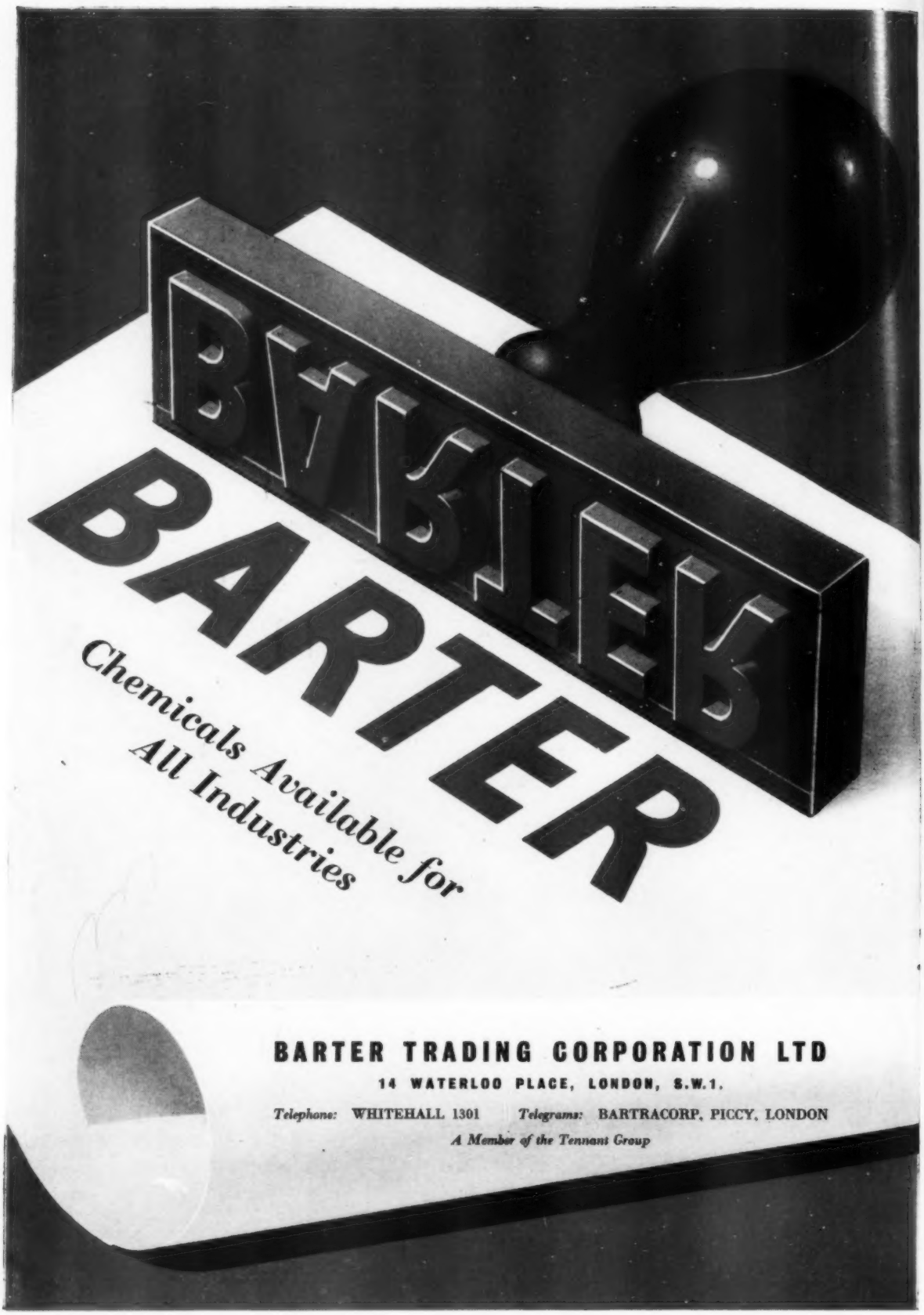
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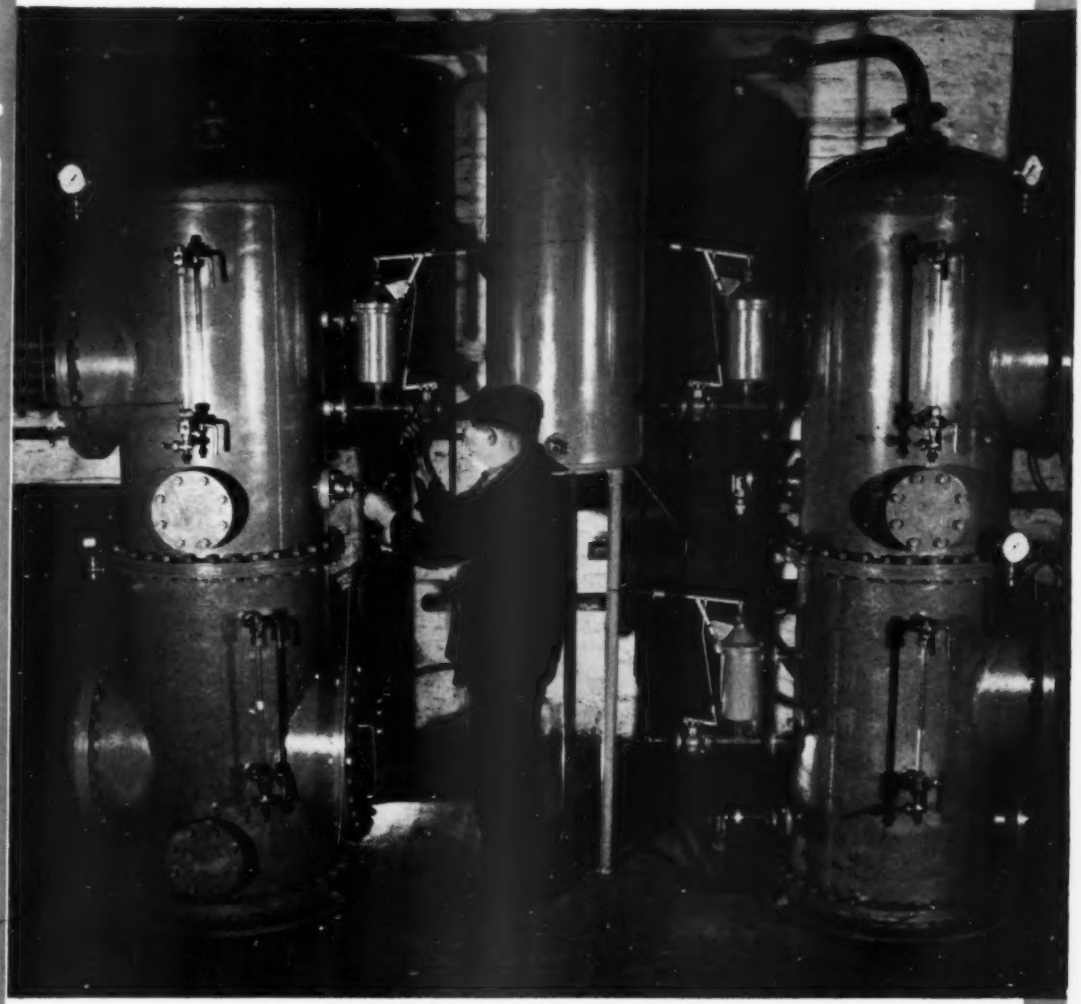

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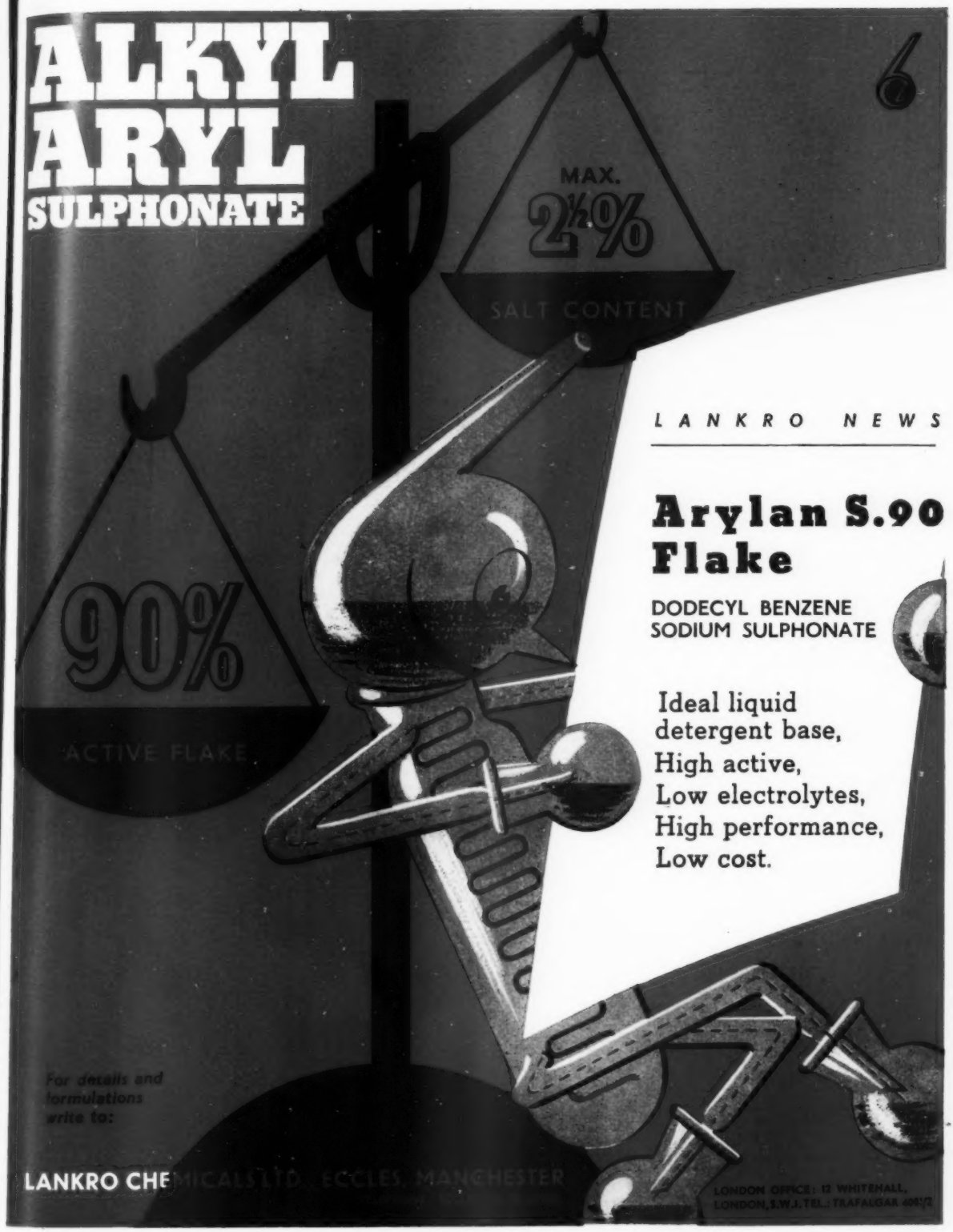
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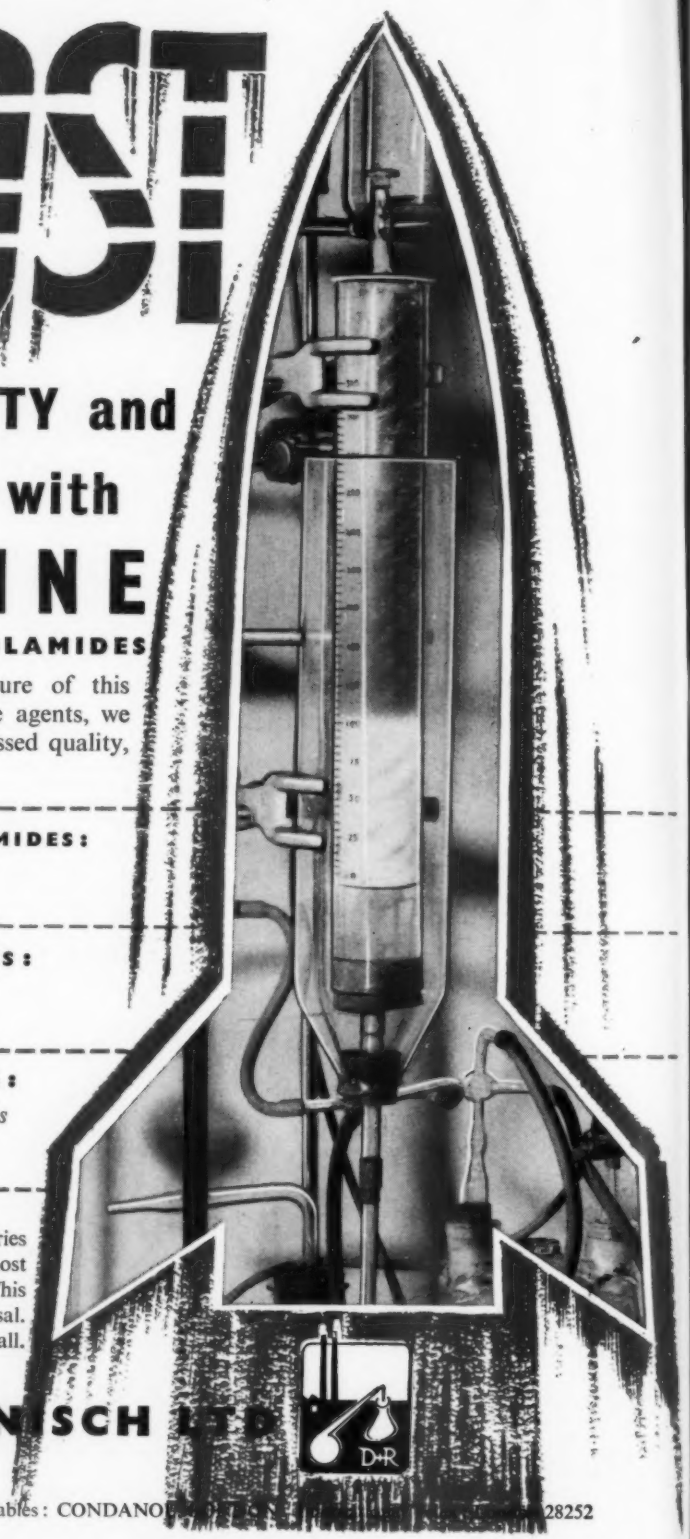

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MANUFACTURING CHEMIST
and Manufacturing Perfumer

Vol. XXIX, No. 5 — MAY, 1958

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A Publication of the Leonard Hill Technical Group—ENGLAND: Leonard Hill House, Eden Street, London, N.W.1 (Euston 5911); UNITED STATES: 3 Villa Drive, N.E. Atlanta, Georgia; 498, S. San Vincente Blvd., Los Angeles 48, California, Webster 3-5706; 1808, Union Bower Road, Irving, Texas; 121, Ward Parkway, Kansas City, 12. Mo.; Room 5632, Grand Central Terminal, New York 17, N.Y.; 681, Market Street, San Francisco 5, California, Exbrook 2-2612; ITALY: Via Filippo Turati 3 (Palazzo Giardino), Milan; SWITZERLAND: Sulgenbachstrasse 36, Berne; HOLLAND: Central Bureau Voor Verkoopontwikkeling, Vechstraat 10, Heemstede. Haarlem; GERMANY: Auf der Reide 20a, Dusseldorf-Unterrath; FRANCE: 63 Avenue Kléber, Paris XVI[e]

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Running to save m'lady

RUNNING FOOTMEN were accustomed to running in front of their masters' carriages, clearing the way ahead, but sometimes they had more exciting tasks to perform. During the reign of the first Elizabeth, Lord Berkeley's wife fell ill and Langham, running footman to his Lordship, "carried a letter from Callowden to old Dr. Fryer, a physician dwelling in London, and returned with a glass bottle in his hand, compounded by the doctor, for the recovery of her health, a journey of 148 miles performed by him in less than forty-two hours, notwithstanding his stay of one night at the physician's house; which no one horse could have so well and safely performed; for which the Lady shall after give him a new suit of clothes."

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TOPICS AND COMMENTS

Facts and fables

AT THE opening of the Cyanamid-Lederle factory at Gosport, described on another page, the managing director of Cyanamid of Great Britain Ltd., Mr. O. N. Williams, took the opportunity to demolish some myths about drug costs. Firstly he pointed out that taking the cost of living index for 1953 at 100, the index of prices of medical speciality products was now 86 and the index of wholesale prices for drugs and pharmaceuticals 102. Secondly he argued that the cost of prescribing should not be viewed in isolation; for instance, taking the weekly cost of keeping one person in hospital at about £20, a drug costing 30s. per week to administer might halve the time spent in hospital.

Critics of drug costs almost invariably refuse to consider the economic benefit conferred on the country as a whole by effective medication. A person in hospital costs money two ways: the indirect cost and the loss of his working time. Waiting lists for hospital beds have fallen each year since 1953; in 1956 the figure was 431,000, about one-fifth lower than 1950. The modern drugs that the doctor can prescribe—drugs that cure rather than alleviate symptoms—must surely take a large part of the credit for keeping the nation healthy and active. If this argument is admitted then it must be conceded that drug firms must be given the wherewithal to carry out the expensive work of discovery and development. It is no coincidence that it is American firms which have set the pace in pharmaceutical discovery and research. There is only one reason for this, they are richer than their competitors here and elsewhere. Would the opponents of the drug industry have us completely dependent upon foreign countries for pharmaceutical research? If, at the same time, they insist on Britain having the finest medical service in the world, then the result of their confused policy would be that the country would have to pay in increasing amounts in scarce foreign exchange for the latest drugs. These people must realise that they cannot get something for nothing. The best medical care and the best drugs are expensive in the short term but cheap in the long. Either British firms are allowed the profits to enable them to carry on research or we become utterly dependent upon America, Switzerland and other countries. This is economic nonsense not only for the obvious reason that it costs us francs and dollars, but also because it cripples our effort to maintain a high level of pharmaceutical exports.

The issue should not be argued on the level of B.P. aspirin tablets or B.P.C. indigestion tablets *versus* proprietaries. If people prefer to buy what suits them that is their affair and advice is easily available. The issue is whether we are going to have a thriving, inventive and productive pharmaceutical industry ready to serve the nation at home and capable of prospering in the export markets, or a debilitated industry slavishly turning out standard remedies and incapable of contributing to world pharmaceutical advances.

Sulphur prices and supplies

IT HARDLY seems six years ago that the world was gripped by a sulphur shortage—more precisely a brimstone shortage—and consumers were anxiously scouring the markets for supplies at almost any price, even to the extent of shipping in sulphuric acid from the Continent. Now, in the midst of a period of over supply, Mr. Langbourne Williams, chairman of the Freeport Sulphur Co., foresees another time of scarcity unless prices are raised. He says that prices are back to the level of the Korean War when there was price control, and reminds us that the shortage was not beaten until price control was lifted and producers found it worth while to exploit fresh deposits. In Mr. Williams's view, if the present trend of low prices continues mines will be shut down and there will be scarcity again. Specifically he is critical of the Mexican producers—whose efforts helped considerably to raise sulphur production—for selling sulphur at too low a price. In short, he wants a higher price for sulphur and a deliberate policy of excess capacity. Such a policy, he thinks, will satisfy consumers that they can plan ahead with confidence as to supplies. An expansionist policy of this kind, thinks Mr. Williams, would treble consumption during the next 25 years, to a total of 50 million tons by 1983 compared with 16 million tons last year.

Mr. Williams is in the brimstone business and naturally he is arguing the case for brimstone. A comprehensive picture of the situation would have to take into account pyrites, spent oxide, anhydrite and even sulphur recovery from oil refineries (now running at 40,000 tons p.a. in the U.K. alone and soon to be increased). The development of pyrites plants and sulphur-from-oil plants in the past six years makes one wonder if the world will ever again face a sulphur shortage like that of 1951-52. It is difficult to believe that the three British anhydrite plants—capable of producing over 300,000 tons of sulphuric acid p.a.—will be allowed to fall into disuse. If a Labour Government is returned at the next General Election it is even possible that there would be a Government subsidy to keep these plants going, so strongly do the Socialists believe in insurance against world shortages.

Projects for by-passing brimstone have been developed in France, Poland, Canada and other

countries. The most spectacular is the production of sulphur from natural gas at the Lacq gas field in South-west France. The factory there is already capable of producing 70,000 tons p.a. of sulphur—which covers more than 25% of present French needs. When in full operation in three or four years, it will produce 1 3 million tons p.a. of sulphur, placing France next to the U.S. (currently 7 million tons p.a.) in the list of world sulphur producers.

All this does not seriously diminish the importance of brimstone or detract from the remarkable achievements of American and Mexican producers in opening up new domes, often in extremely difficult places (the latest Freeport mine is Grand Isle 6 miles out in the Gulf of Mexico in 50 ft. of water!). However, it will be pyrites, oil, anhydrite and underground gas, as well as brimstone, that will satisfy the world's growing hunger for sulphur in the future.

Ten years of WHO

WHEN the World Health Organisation was formed in 1948 and assigned the task of combating international disease it could not have visualised the success that has been achieved.

It has now a membership of 88 States, and millions of people are enjoying a better standard of living because of the work of WHO teams.

Most of the communicable diseases such as diphtheria, measles, scarlet fever and whooping cough are disappearing and an outstanding triumph after many setbacks has been the retreat of malaria. Complete eradication of this disease is foreseen within the next 10 years.

The introduction of educational schemes in underdeveloped countries, sanitary regulations, and information services are all responsibilities of the organisation. The International Pharmacopœia, published for a second time in 1955, contains monographs for 400 pharmaceutical preparations which are recommended as bases for national specifications. In the field of biological standardisation, 50 new standards have been issued, ranging from diphtheria antitoxin to a series of antibiotics. In this work more than 100 laboratories from all over the world have co-operated.

A man-made danger to health is the problem of radiation hazards, and an energetic programme is being carried out in this direction.

If this record seems to more than justify its existence, Dr. M. G. Candau, WHO's Director-General, allows himself no complacency. In an epilogue to a booklet by Ritchie Calder entitled "Ten Steps Forward" he says: "There is no boasting of achievement, because whatever we may have succeeded in doing is insignificant compared with what remains to be done."

Efforts are being concentrated in the fields of cancer, poliomyelitis, cardiovascular diseases and mental diseases, and the next decade holds promise of even greater steps forward.

Prospects for fertilisers

THE latest FAO review of world fertiliser production and consumption—for 1957—has one important difference from previous reviews in that the first post-war decade, 1946-47 to 1956-57, has been surveyed. Changes occurring over a ten-year period give a much better guide to progress than annual fluctuations. Those who assumed that expansion in fertiliser use would decline after the war have been proved to be pessimists. Consumption has in fact increased more than two-fold since 1946-47. Fertiliser-providedn utrients (as N, P_2O_5 and K_2O) have risen from 8,850,000 tons p.a. to 20,639,000 tons. By any standards this is an impressive increase.

The increase in world use is almost certainly greater than that shown by FAO data, because their records exclude the U.S.S.R., China, North Korea, and much of the Communist part of the world. There is plenty of other evidence that fertiliser use in these countries has also increased heavily. China has become a large importer and is said to be creating a substantial fertiliser industry.

There is still enormous room for further expansion. Taking countries where fertiliser use is well developed, their 1946-47 usage has risen from 7,599,000 tons of nutrients to 16,964,000 tons. In the rest of the world, it has risen from 1,251,000 tons to 3,675,000. That is to say, the rate of increase where fertilisers were well established has been almost as high as in countries where use was very low. But despite 10 years of large expansion, over 80% of world fertiliser production is still being applied to under 40% of world farmland. Disparity in rate of fertiliser use is still very great. The low-using 62% of world farmland uses even now only 2 metric tons of nutrients per 1,000 hectares; against 14·6 tons per 1,000 in the remaining 30%.

Population pressure on available farmland is the main stimulant to the use of fertilisers. Japan uses 215 tons of nutrients per 1,000 hectares, while New Zealand uses only 19 tons per 1,000. It is in Asia that population pressure is high and fertiliser use is low; so Asian use is showing bigger gains per year than Latin American or African.

Consumption in Britain, though it has steadily continued to increase, is not impressively high by Western European standards, despite the fact that our land/population ratio should make us a leading user. We are now applying 52 tons of fertiliser nutrients per 1,000 hectares compared with 199 tons for Belgium, 196 tons for Holland, 140 for Norway, 135 for Western Germany, 121 for Denmark. In fact we are below the average for Western Europe, which stands at 55 tons. It is not irrelevant that the recent review of agricultural price supports offers a further increase in fertiliser subsidy payments although cutting support for some major farm products.

* "Annual Review of World Production and Consumption of Fertilisers, 1957." F.A.O., 1958. pp. 89. 5s., through H.M.S.O.

Boron story

PRODUCTION at high cost of hydroboron and borane "high energy fuels" for ram-jets and guided missiles is adding a new chapter to the history of boron. We had become so used to thinking of the element in terms of borax and boric acid for lotions, cosmetics, ointments and medicated products, and sodium perborate for tooth powders, deodorants and so on, that any large-scale applications of boron itself seemed impracticable. But when Davy and, independently, Gay-Lussac and Thenard first liberated boron from boric acid just 150 years ago, they referred to amorphous boron as very reactive particularly when undergoing "vigorous oxidation"—almost a prediction of things to come. With pentaboron now being produced for fuels at 1,400 dollars a gallon, we see a culmination of this development of boron which includes borides of titanium, tantalum and tungsten, boron steels in control rods and tubes in nuclear reactors, and amorphous boron in delay fuses, flares and propellant mixtures.

Many chemists have regarded boron as a rather dull element, insignificant enough indeed to merit the name given by the two French chemists who prepared it—"bore." But its history is not without highlights. For instance . . .

Up to 1926 calcium borate or colemanite was the dominant source of borax via the reaction with sodium carbonate, one chief source being Death Valley in California, as the textbooks mention. But delve deeper into this winning of borates from that waterless alkali desert before the railroad came, and the story rivals fiction with remarkable photographs of "Borax Bill" Parkinson driving his "twenty-mule" team.

For a second highlight we go to Tuscany, to those volcanic steam jets or "fumaroles" so well pictured in Mellor's classic texts for students. By 1815 a process of slow evaporation had been established in artificial lagoons to yield natural boric acid. A team of imaginative Italian engineers under Conti of the Società Boracifera di Lardarello completely changed matters. Daringly they drilled fresh fumaroles, fixed steel casing-heads to harness the enormous steam pressures, and as by-products from such natural energy extracted boric acid from condensates and ammonia and carbon dioxide (hence ammonium carbonate) from the gases evolved with the steam. The old idea of preparing the pure boron by magnesium reduction has proved of little use in practice; for boron suboxides and other impurities remain even after treatment of the product with hydrofluoric acid. Then came the reduction of boron trichloride with hydrogen in an arc process, with the element in some cases deposited on a heated tungsten filament. Next followed electrolytic processes involving molten baths of potassium fluoborate with potassium chloride flux, a procedure in which the potassium set free reduced the fluoborate to boron (with a reminder that Davy and Thenard used potassium for reduction 150 years ago!).

From the project begun in America in 1952 and appropriately named ZIP the production of exotic boron fuels has developed. Since liquid hydrogen is out of the question, beryllium is so toxic and lithium hydride a doubtful proposition, boron hydrides or alkyls were left among the lighter elements with high energy potential. The favourite is pentaborane B_5H_9, with $B_{10}H_{14}$ also in production.

Glaxo-Allenbury

IF we may paraphrase an old slogan, "Glaxo Builds Bonnie Businesses." That must certainly be one reaction to the news that Glaxo Laboratories Ltd. have arranged a merger with Allen and Hanburys Ltd. The move is shrewd and well planned and it exemplifies the drive and foresight with which Sir Harry Jephcott, chairman of Glaxo, has made his company one of the foremost pharmaceutical houses in the world. Apart from its proprietary foods, Glaxo is chiefly known for its antibiotics, vitamins and vaccines. The new merger will bring a complementary range of products, notably insulin, antihistamines, sutures and surgical equipment.

Of the two companies Allenburys is much the older, having originated in the City of London in 1715. The most distinguished member of the Allen family was William Allen, F.R.S., first president of the Pharmaceutical Society. The Hanburys too have long associations with professional and manufacturing pharmacy. Glaxo had its origin with the New Zealand business of Joseph Nathan Ltd., set up in 1873. The Glaxo Co., formed in 1899, remained a section of Nathan's until 1935 when Glaxo Ltd. was formed. Twelve years ago Glaxo Laboratories Ltd. was launched as a public company and immediately began to make pharmaceutical history with its penicillin factory at Barnard Castle. Streptomycin, vitamin B_{12} and polio vaccine have followed, besides notable advances in nutritional products.

Glaxo is a much bigger company than Allenburys. Glaxo Ordinary Issued Capital is £4·7 million; Allenburys' £488,400. Shareholders of Allenburys have been offered three ten-shilling Glaxo Ordinaries for each of their £1 Ordinaries, an offer far too attractive to turn down. After the announcement of the merger Allenburys £1 shares went up by 41s. 3d. to 106s. 3d., a very handsome gain indeed.

Each company will retain its own name, individuality and pattern of business and will continue to trade as at present. Obviously, however, there will be integration of research, production and marketing policies. The competitive edge of the British pharmaceutical industry should be sharpened by the alliance.

Animal calm

EVEN the townsman who couldn't care less about farming has a picture in his mind of placid, cud-chewing cows and it requires no great exertion to believe that animals who live without tension are likely to be fitter and more productive. Thus, the idea of adding tranquillisers to animal foods seems to have good prospects for success. There are two distinct fields of use: administering tranquillisers to animals at times when fear-stress is likely, or feeding them as regular dietary supplements. The former is established; the latter seems to require considerably more investigation.

The transport of cattle inevitably causes stress. Even domestic pets tended with loving care can display nerve stress during a journey. The mass transport of livestock from ranges to towns, especially in large meat-producing countries, must create intense fear. In the United States what is called " shipping fever " is said to cost 25 to 100 million dollars a year. Even where fatal or debilitating diseases are not induced by transport stress, meat quality is commonly reduced by pre-slaughter agitation. However much attention is given to transport and livestock marketing conditions, animals fresh from the open range go off their food when herded into lots and stress excitement also causes much damage by bruising. Indeed, the whole problem is one to which a meat-eating civilisation has shut its eyes, not entirely callously, but because the problem seems formidable and inevitable. The same tranquillising drugs developed for human stress are already making a strong bid to ease if not solve this problem. Derivatives of phenothiazine, reserpine, diphenylmethane and the substituted propanediols are all being offered as veterinary preparations, usually for oral administration but in some cases to be given by injection. One tranquilliser of French origin, a phenothiazine type, has been developed solely for animal use without any history of human administration. This " time-of-stress " use of tranquillisers for farm animals may well expand, for anxieties also occur when animals are weaned or when in-winter yard conditions are suddenly changed to grazing conditions, or *vice versa*.

The value of tranquillisers as regular feed additives seems much less certain. Some tests have shown that animals gain weight as a result of small and regular inclusions of tranquillising drugs in their diet. The surest positive evidence has been obtained when tranquillisers accompany other growth-promoting additives; when given as the only kind of feed additive, weight gains have been slight. However, much more feeding-test research is clearly needed before conclusions can be reliably drawn. The feed-additive market for tranquillisers would be very large, possibly comparable with the feed-additive market for antibiotics. A total market worth $20 to $50 millions has been conservatively estimated for U.S. agriculture alone. But first there must be more evidence to prove that tranquilliser supplements bring worth-while weight gains, and even then official sanction for the regular use of these drugs in cattle foods must be obtained.

Words of caution

EDUCATION in safety is one of the best jobs done by the Association of British Chemical Manufacturers. An excellent example of this work is the scheme for marking containers of hazardous chemicals put forward five years ago in the form of an instruction manual. This scheme has done a great deal towards simplifying and standardising cautionary labelling and constitutes a powerful safeguard to all concerned with the handling, transport and storage of hazardous chemicals, up to and including the time a container is opened for use in the premises of the consumer.

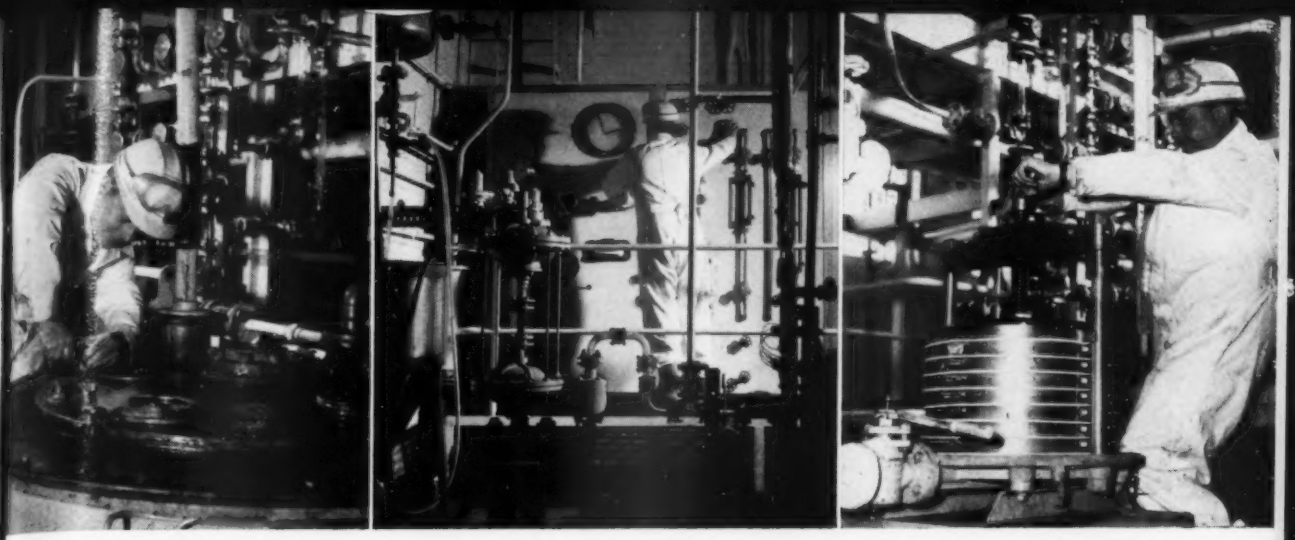
Almost every A.B.C.M. member who makes hazardous chemicals uses the recommended markings. Many have incorporated an A.B.C.M. label into a composite label with others. Some require their suppliers to label their products with an A.B.C.M. label. Others fix A.B.C.M. labels to containers received in their works as a safeguard to their staff.

Now a second edition of the Manual has been published (available from the Association at 10s. ($2.50) post free). It has been completely revised and brought up to date and the list of labels has been extended to cover 331 products. The labels contain a single word, a statement of the main hazards and precautions to be taken, and advice on action in case of accident using a standard format and phraseology.

Among the more important changes in the new Manual are that only one label size is now recommended whereas previously there were two, and that chemicals which must by law be labelled " Poison " under all circumstances, and whose only hazard is toxicity by ingestion, have been omitted from the list of recommended labels because the statutory wording is considered to give sufficient warning. A list is also given of substances which have been considered for inclusion and rejected for various reasons. A number of minor changes have been made for the sake of consistency, but it has not been necessary to alter the basic principles.

The Manufacturing Chemists Association of America has a similar scheme in the United States, and close contact is maintained with a view to bringing the two schemes into as close agreement as possible having regard to the different conditions and legislation in the two countries.

An encouraging interest has been shown in the A.B.C.M. scheme by other industries, by transport organisations, by the Factory Department and by the International Labour Office which is preparing an international manual of guidance for labelling schemes based on the A.B.C.M. and M.C.A. schemes.



Three views in the Aureomycin plant where the crude product made under contract by Boots is refined by crystallisation in solvents. Left: an operator adjusts a centrifuge. Centre: the control panel; a proportion of the crude antibiotic is converted into Achromycin, the necessary hydrogenation process being carried out in a stirred reactor in a room immediately behind this panel. Right: an operator adjusts a filter.

Cyanamid-Lederle Factory Opened

Chemical Manufacture and Pharmaceutical Processing Under One Roof

A new factory for the manufacture and pharmaceutical processing of antibiotics and other specialities has been opened at Gosport, Hampshire, by Cyanamid of Great Britain Ltd., for its Lederle Laboratories Division. Here is a description of this £700,000, 300-employee factory which was built in the record time of 15 months.

THE British Cyanamid organisation was established in London in 1923 under the name Cyanamid Products Ltd. The present name, Cyanamid of Great Britain Ltd., was assumed on January 1, 1957. Manufacturing operations were started in 1951 when a plant for refining crude Aureomycin was opened at Hirwaun, South Wales. The crude material was and is made under contract for the company by Boots Pure Drug Co. at Nottingham. The new factory at Gosport provides more and better facilities for these operations and also for the manufacture of *Achromycin* tetracycline, a derivative of Aureomycin; *Diamox* acetazolamide, a new type of oral diuretic; and *Artane* trihexylphenidyl, an antispasmodic.

The new building lies beside the Gosport-Fareham road in a "garden" site of 18 acres. It consists of a single-storey factory, a double-storey office block, a gatehouse, an electricity sub-station and a tank farm, consisting of five 3,000 gal. and two 10,000 gal. tanks containing solvents, fuel oil, acids and alkalies.

The buildings cover 100,000 sq. ft. The whole plant has been designed to fit into the production pattern. A U-shaped route is taken by raw materials from the receiving platform, to warehouse, processing, packaging and dispatch. As production increases additional warehousing can be provided along one side of the U, while production facilities can be extended along the bottom of the U.

The oil-fired heating system is powered by two fully-automatic boilers, each with an output of 6,000 lb. of steam an hour. Heating throughout the warehouse and chemical areas is by steam unit heaters. In the chemical section, all motor and control equipment is of flame-proof design, and all unit heaters are provided with fresh-air inlets to replace the air withdrawn by the process extraction equipment.

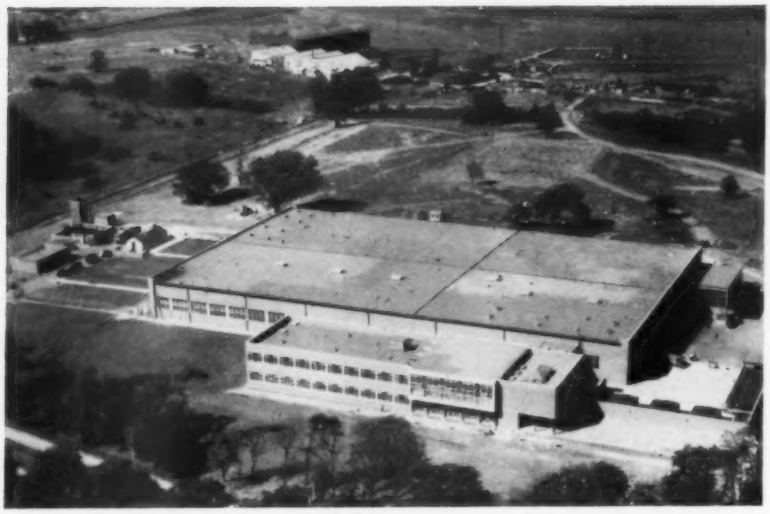
Production

Raw materials enter the plant in two ways. All bulk liquid chemicals are discharged from road tankers into the five sunken storage tanks already mentioned. Other raw chemical materials—those in powder form, and also packaging materials—are received at the warehouse, and remain in quarantine until released by the control laboratory. They go then to either chemical store or packaging store.

After assay, liquid chemicals are fed, through underground pipes, from the tank farm to the antibiotics and synthesis plants. At the farm is a water demineralising unit connected by pipeline to the factory. In the antibiotics plant, solvents are stored in holding tanks just below the roof.

Aureomycin refining

Crude Aureomycin is refined by crystallisation from selected solvents under carefully controlled conditions of *p*H. The antibiotic is



The new factory lies beside the main Gosport-Fareham road in a pleasant 18-acre site

dissolved in 1,000 litre glass-lined stirred reactors. The solution is clarified through a Seitz type filter and pure Aureomycin is crystallised in various of the 1,000 litre glass-lined reactors above. The purified crystals are recovered in a centrifuge, washed with solvents and dried.

A considerable proportion of Aureomycin is converted into Achromycin by de-chlorination. Hydrogenation is carried out in a stirred reactor, housed in a separate room. The biological activity of all antibiotic products is tested microbiologically in a special laboratory which also checks the sterility of various products, including surgical sutures.

Synthesis plant

Next door to the antibiotics plant is the synthesis plant where drugs such as *Artane* and *Diamox* are manufactured in powder form for the pharmaceutical section.

Artane preparation involves a five stage synthesis and is normally carried out in glass reactors of 10 to 100 litre capacity. *Diamox* is synthesised from relatively simple basic organic chemicals in six stages which include chlorination and acetylation. The various reactions in this synthesis are carried out in fourteen 100-litre glass-lined vessels and rubber-lined equipment is used for centrifugal filtration.

Chlorine used in this process is received in 1-ton cylinders which are stored in the outside gas station and piped to this department for use.

Both the antibiotics plant and the synthesis plant are brightly painted in various high-gloss colours. Following the American routine, all workers wear safety helmets.

Before any bulk pharmaceuticals manufactured by the chemical section are released to other parts of the factory they go back to the chemical stores for analysis and clearance.

The pharmaceutical section is divided into four parts—tablet department, ointments and liquids, sterile department, and encapsulation.

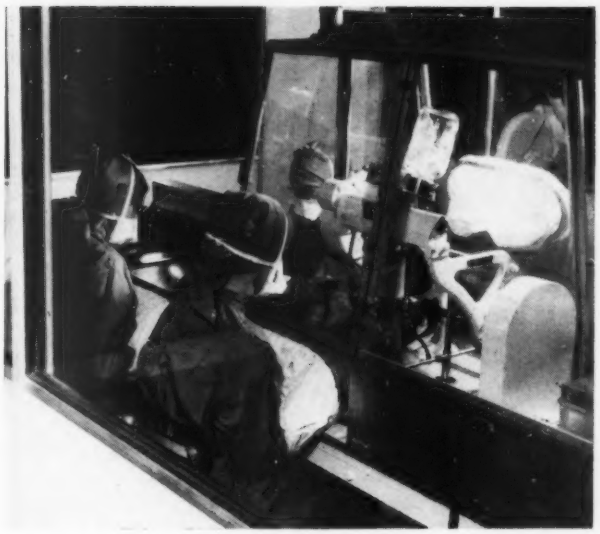
Tablet manufacture

Powders for tablet manufacture are blended in Morton mixers. The final blend, processed in a Gardner horizontal mixer, consists of active ingredients plus excipients, bonding agents, etc. At various stages preparations such as the gelatin solution are added to convert the powders into a moist mass. This mix is then passed through a high-speed Fitzpatrick mill (by Apex Construction) and emerges as wet granules which are laid on to stainless steel trays and dried in a L. A. Mitchell oven. When the drying process is completed the dried granules are passed through a second high-speed hammer mill and lubricants are added to ensure smooth running on the compressing machines.

There are two heavy-duty Manesty machines each of which is capable of turning out approximately 20,000 tablets an hour. There is also a Manesty single punch machine which produces 5,000 tablets an hour. In addition there is a Manesty BB3 machine on which,

The ingenious Accogel encapsulation machine designed and built by Cyanamid engineers. The two strips of gelatin can be seen converging on to the die rolls where the powder is filled in and the capsules are formed, afterwards going to the rotating smoothing pan.

One of the two electronic batch counters which fill tablets and capsules into bottles. Accurate counting is essential in packaging expensive drugs. The machine, with four filling heads, is made by C. E. King and Sons Ltd.



Girls at work in the sterile packaging room.

for example, *Artane* tablets are produced. This has an output of something like 80,000 tablets an hour.

Although the greater proportion of the tablets manufactured are uncoated, some tablets are sugar coated, for example the *Achromycin* 250 mg. tablets.

Ointments and liquids

Fats taken from chemical stores are held in a hot room at 80°C. until liquefied. A proportion of the melted fats is pumped into a premix tank which is situated vertically above the main blending tank; the remainder of the fats is pumped directly from the hot room into the main blending tank, where it is held at a temperature of 50°C. The active constituents of the ointment previously micro milled are blended with the contents of the premix tank and the mixture passed through a colloid mill into the main blending tank below. The entire batch is then reblended, and piped to a holding tank where a sample is withdrawn and held under assay.

The general arrangement of the plant in the liquids section follows a similar pattern.

Sterile department

Parenteral products are manufactured under aseptic conditions. First, the vials, rubber plugs and aluminium seals are washed repeatedly in ordinary and finally lint-free water, in a non-sterile area. Bulk powders are sterilised by an ethylene oxide process, sampled, and fed into an Autopack powder filler for bottling. Rubber plugs are inserted in the bottles which are then sealed. Gowns, masks and caps used by staff in this section are sterilised in an autoclave.

Encapsulation

The preparation of the gelatin takes place in a special room where specific colours are used for different types of capsules. The gelatin is also flavoured. The dry filled encapsulation process used is unique, the Accogel machine being the result of much research and development by the parent company.

The molten gelatin is cast into separate films of controlled thicknesses. One film is drawn over the die roll where pockets are formed in it by vacuum. The second film which passes above the rolls is printed with the company's name.

Essentially the encapsulation is as follows:

Accurately measured quantities of the powder to be encapsulated are discharged into the gelatin pockets which have been preformed on the machine. These pockets are then sealed off by the top gelatin film which in the meantime is passing between the sealing roll and the die roll. The sealed capsules are cut out of the gelatin film and blown along the discharge tube into the rotating smoothing pan. The gelatin web remaining after the capsules have been removed is re-used in later batches of gelatin. The capsules are dried in aluminium trays for about 12 hr. under controlled temperature, and relative humidity, float tested, inspected for rejects, coated to improve appearance and then passed to bulk stores for assay.

Surgical products

Processes include preparation and inspection of the suture materials, fabrication of plastic envelopes, winding, sterilisation, and filling and sealing operations; the latter processes being performed under strict aseptic conditions.

The plastic envelopes containing the sterile sutures are filled and sealed in the sterile area, the actual operation being performed in sterile hoods.

The envelope making and sealing machinery was developed and manufactured by the Division's own engineering group. It utilises radiant heat for sealing plastic film.

Packaging

Four packaging lines—one for ointments, two for tablets and capsules, and one for liquids, are operated by neatly uniformed girls, who pack finished products into appropriate containers. Here again, control is strict; a laboratory assistant takes samples for checking, and, in addition, a member of the packaging staff makes an independent check for count, weight, cap tightness and correct labelling. Finally, the products go to despatch where they are collected by lorries for shipment to hospitals, doctors and chemists in 44 countries.

Mixing and Blending

By D. F. Riley, B.SC., A.C.G.I.

During the last three or four years the published literature has shown that more interest is being taken in the design of agitation equipment for particular processes and in the task of establishing some sort of fundamental theory of mixing. In this review Mr. Riley discusses the functional design of mixing equipment, the blending of miscible liquids, the improvement of heat transfer, gas absorption and the mixing of powdered solids.

Functional design of mixing equipment

THE rational design of agitation equipment must be based on a knowledge of the flow properties of the materials being handled. With most liquids the rate of shear varies directly as the shear stress applied, in accordance with Newton's viscosity equation. Many concentrated suspensions, however, show non-Newtonian behaviour of several different kinds. For example, suspensions of sand in water have an interlocking structure and show what is known as Bingham plasticity. A minimum stress, termed the yield stress, is necessary in order for flow to start and after a certain further increase of stress the flow becomes Newtonian.

Some suspensions or solutions of long thin particles exhibit "pseudoplasticity," which means that as the stress increases the increment of stress required to produce a given increase in shear rate decreases rapidly. This behaviour is thought to be due to the progressive alignment of the particles in the direction of flow. The opposite type of flow, known as dilatancy, is characteristic of uncooked starch suspensions and of concentrated deflocculated pigment suspensions. Certain paints, printing inks, food products and suspensions of gypsum and bentonite have an internal structure which changes with time as well as with the stress applied. If the shear stress required to maintain a given constant rate of shear decreases with time the behaviour is known as thixotropy, while the opposite effect is called rheopexy.

When the rheological properties of the materials have been determined the next step in logical design is to consider the duty to be performed—whether liquid blending, suspension of solids, promotion of heat transfer or other process. The specific agitation requirements of these various operations, with particular reference to the ratio of flow to head necessary, have been discussed in two papers by Rushton and Oldshue,[1] who have given a comprehensive survey of liquid agitation based on fluid mechanics. The ratio of flow (Q) to head (H) at constant power input changes rapidly with speed. In general it is found that high Q/H ratios are necessary for blending liquids and suspending solids and these are obtained economically by using large impellers at low speeds. Low values of Q/H, on the other hand, obtainable from small impellers at high speeds, are better suited to gas absorption and the contacting of immiscible liquids.

The relationships governing the scaling-up of agitation data can be derived from the relevant equations. For example, the general equation relating agitation and heat transfer is

$$\frac{hD}{k} = a\left(\frac{D^2N\rho}{\mu}\right)^x\left(\frac{c\mu}{k}\right)^y$$

where h = film coefficient of heat transfer.
D = impeller diameter.
k = thermal conductivity of the liquid.
a = shape factor.
N = impeller speed.
ρ = density of liquid.
μ = viscosity of liquid.
c = specific heat of liquid.
x, y are exponents, x being the " mixing slope."

Rushton has shown that if the same film coefficient is required on the full scale as in the model, and the conditions are those of full turbulence, then the commonly adopted criterion of equal power per unit volume is valid only when the mixing slope $x = 0{\cdot}75$, whereas in practice it can vary between 0·50 and 0·67 depending on the system.

The few data which have been reported on the velocity of discharge from impellers are augmented in a paper by Sachs and Rushton.[2] A 4 in. diam. turbine with four flat blades was rotated in a cylindrical glass tank 11½ in. diam. equipped with four longitudinal wall baffles. An immiscible liquid system was used and measurements made of the radial, tangential and vertical components of velocity by means of a photographic technique. It was found that the maximum flow occurred at a radius of about 4 in. independently of speed, the difference between it and the peripheral flow being the amount of entrained liquid.

The flow pattern actually produced by an agitator depends not only on its speed, diameter and shape but also on the presence of baffles, the location of the impeller in the tank and on the arrangement of such obstructions as cooling coils.

Blending of liquids

The rate of mixing of a small amount of potassium chloride solution into water has been measured by Kramers, Baars and Knoll[3] using an electrical method. A three-bladed propeller and two six-bladed turbines of different shapes were tested in two vessels, 12½ in. and 25 in. diam. Longitudinal baffles at the tank wall and away from the wall were compared with each other and with a cruciform baffle on the tank floor. In unbaffled tanks more rapid mixing was obtained by placing the vertical shaft off-centre or by inclining the shaft 15° to 20° to the vertical and directing it across a

diameter of the tank. The cruciform baffle was found to be effective only if the propeller was close to the bottom of the vessel. The wall baffles were found to be more effective than those set away from the wall when the propeller was used, but less so when the turbines were used. It was confirmed that turbines require more power than propellers to achieve the same rate of blending under the same conditions.

The rate of blending of miscible liquids by means of jets and marine propellers has been compared by Fox and Gex.[4] Liquids of a wide range of viscosity, in tanks from 6 in. to 14 ft. diam., were agitated by propellers of 1 in. to 22 in. diam. and by jets of $\frac{1}{16}$ in. to $1\frac{1}{2}$ in. diam. The results were correlated in terms of a "mixing time factor" which was found to be a function of the Reynolds number $Re = \left(\frac{D^2N\rho}{\mu}\right)$ and equations were given for the time of blending under turbulent conditions ($Re \geqslant 10^4$ for a propeller and $\geqslant 2000$ for a jet).

Oldshue, Hirschland and Gretton[5] have reported measurements of the blending time of hot and cold water in three cylindrical tanks, the largest of which held 58,000 gal. Side entry propellers were used and the minimum blending time was obtained when the impeller shaft was horizontal and pointed about 10° off centre. A layer of hot water was floated on to a deeper one of cold water, care being taken to avoid interfacial mixing. The course of the blending was followed by means of a series of thermocouples placed at various levels in the tanks. It was concluded that the blending of low viscosity liquids is principally a matter of pumping rate and that therefore the selection of an agitator to perform this duty is a compromise between the higher capital cost of a large low-speed propeller and the lower mixing efficiency of a small high-speed one.

Heat transfer

The use of agitation to improve or control a heating or cooling process is a feature of the design of several types of chemical plant including evaporators, crystallisers, water-cooled and refrigerant-cooled reaction vessels. Where heat transfer is the only consideration the agitation will be designed to give as high a coefficient of heat transfer as is economically feasible. Usually, however, other operations such as the suspension of solids or the absorption of gases are simultaneously involved and a compromise has to be sought between conflicting requirements. If the heat transfer surface takes the form of a coil in the vessel it must be so arranged as to allow free circulation of the liquid around it.

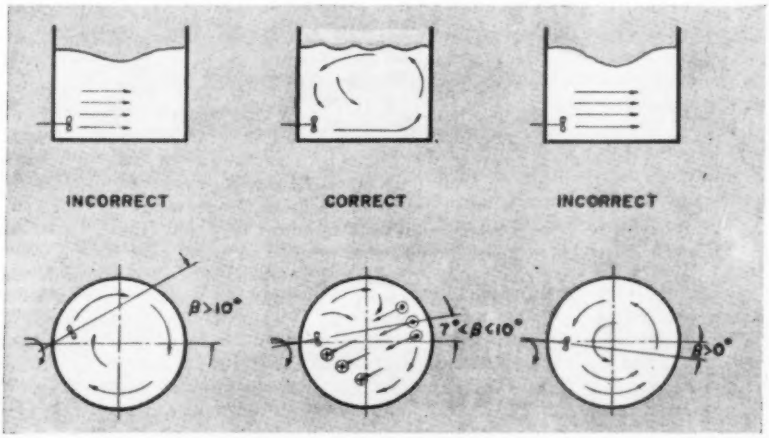
Heat transfer coefficients for helical coils in a vessel agitated by flat-blade turbines under fully baffled conditions have been reported in a paper by Oldshue and Gretton.[6] Oil and water were agitated separately in a tank 4 ft. diam. × 4 ft. 8 in. high provided with 4 in. wide vertical baffles. The impellers had six blades 12 in. —28 in. diam. and two sizes of coil were available. When oil of 50 cp. viscosity was being agitated a coil tube spacing of 4 diameters gave a lower coefficient than a spacing of 2 diameters. The larger the impeller, at constant power input, the higher the film coefficient was found to be, thus confirming the importance of volume circulation in the promotion of heat transfer. Vertical tubes arranged so as to act also as baffles have been suggested as a heat transfer surface, but Oldshue and Gretton calculate that the overall coefficient obtainable is very little better than that given by helical coils.

Gas absorption

Experimental work on the oxidation of a dilute aqueous sodium sulphite solution by air in agitated reactors is reported by Green.[7] Two reactors were used each fully baffled and with a single 12. in diam. turbine, one being fitted with a draught tube and driven at 500 r.p.m., the other revolving at 360 r.p.m. The latter reactor gave a reaction rate two or three times greater than the one with the draft tube. Several different reactor designs were tested using the same oxidation system, and in general it was found that high-speed reactors producing considerable bubble aeration were less effective than those giving little aeration. When the air pressure on a 50 gal. unbaffled reactor with a high-speed propeller was increased by 7 p.s.i. the reaction rate was doubled, thus indicating the importance of the partial pressure of the gas.

Ayerst and Herbert[8] carried out the absorption of pure CO_2 in a 10% aqueous ammonia solution in a laboratory vessel $5\frac{1}{4}$ in. diam. and in a pilot plant vessel 20 in. diam., but since the vessels were not geometrically similar the results obtained are of no use for scaling-up purposes. Both vessels were equipped with cooling coils, the smaller one having a paddle agitator and the larger one a 6 in. vaned disc impeller. They confirmed the earlier results of Cooper, Fernstrom and Miller that at the same gas velocity the volumetric absorption coefficient depends on the power input per unit volume. The loading velocity was found to be about $1\frac{1}{2}$-2 f.p.m. for the paddle and 5 f.p.m. for the vaned disc.

Experiments have been carried out by Vermeulen and his co-workers[9] to determine the interfacial area in two-phase systems such as are involved in gas absorption or the contacting of immiscible liquids. The vessels used were 10 in. diam. × 10



Optimum positioning for side-entering propeller-type mixers. (Ref. 5.)

This and the following two illustrations appear by permission of Chemical Engineering Progress.

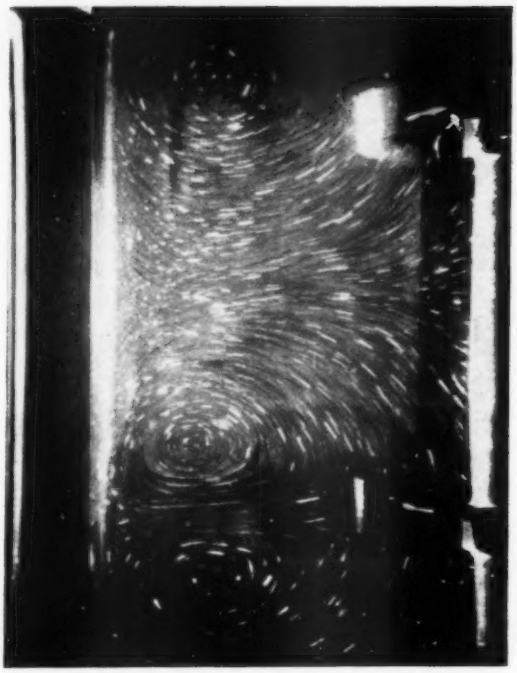
in. high and 20 in. diam. × 20 in. high, each provided with four wall baffles and the impellers were four-bladed flat paddles about 7 in. diam. run at speeds in the range 100-400 r.p.m. A photo-electric method was used and the data obtained on drop diameters had poor reproducibility which was attributed mainly to the effects of trace impurities at the interface.

The mean drop diameter was found to be inversely proportional to the nth power of the agitator speed where $n=1{\cdot}2$ for liquid-liquid systems and 1·5 for gas-liquid systems, and proportional to the 0·6th power of the interfacial tension. The effect of volume fraction of the disperse phase on the interfacial area per unit volume was studied, but a clear relationship could not be established, since the particle size was affected at the same time.

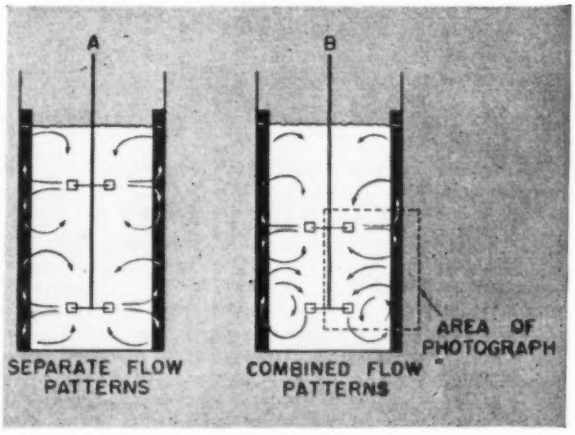
Vessels used for gas absorption (*e.g.* fermenters) are often very deep in relation to their diameter and it is common therefore to find several impellers fitted on the same shaft. Rushton, Gallagher and Oldshue[10] have studied the effect of impeller spacing on the absorption coefficient in such vessels. Two tanks were used, 6 in. and 12 in. diam., fully baffled, the larger one being provided with a sparge ring for air admission. Absorption coefficients were measured by the usual sodium sulphite oxidation technique. It was found that at high power inputs and air flow rates the absorption coefficient was 10% higher for dual turbines (spaced 2½ dias. apart) than for a single turbine at the same power input. Any greater improvement than this would necessitate spacings too large to be practical. If the turbines are brought too close together the flows from them interfere with each other, the power consumption falls and a mixture of axial and radial flow is produced which depends critically on the geometry of the system.

The very complex mechanism of oxygen transfer from air bubbles to the liquid medium and thence to the suspended solids in three-phase systems such as are found in fermentation and activated sludge processes is far from being fully understood. Work has been done, however, on the effect of aeration and agitation in large-scale antibiotic fermenters with a view to scaling up from pilot plant data. The scale-up of a penicillin fermenter from a 5 gal. vessel through 2,000 gal. to a 24,000 gal. commercial reactor has been described by Wegrich and Shurter.[11] The 2,000 gal. reactor was baffled and contained 3 in.-28 in. diam. flat blade turbines run at 80-150 r.p.m. using 0·3 to 2·5 h.p./100 gal. Filtered air was metered to the vessel at 24 p.s.i.g. and at rates varying up to 150 c.f.m. With a superficial air velocity of 2·1 f.p.m. it was found that the penicillin production rate increased linearly with time provided the power input exceeded 0·5 h.p./100 gal. The commercial production vessel was not in all respects geometrically similar to the 2,000 gal. reactor, so that the scale-up could not be based on dynamical similarity. The large reactor was worked at a power input of 0·7 h.p./100 gal. and a superficial air velocity of 2·1 f.p.m.

The rôle of agitation in effluent treatment plants using the activated sludge process has been discussed in several recent papers. At low air rates porous diffusers give a fine dispersion of air in the liquid, while at rather higher rates simple nozzles are found to give higher mass transfer coefficients than porous spargers. At still greater flow rates mechanical agitation becomes necessary, not only to maintain the required oxygen level, but also to break up the flocs of sludge which hinder oxygen transfer.



Trace photograph of dual turbine flow. (Ref. 10.)



Flow patterns—dual turbines.(Ref. 10.)

Kalinske[12] used radial flow turbines 3 in.-12 in. diam. in a 30 in. diam. tank fitted with a sparge ring below the impeller. The effects of air rate and turbine speed on the O_2 absorption efficiency were determined and an empirical equation deduced. Efficiencies of up to 40% were found to be possible with mechanical agitation as against 5-7% for porous diffusers, but the power consumption would be excessive. The minimum total power consumption, for air compression as well as agitation, was reached at oxygen absorption efficiencies of the order of 10-12%.

Oldshue[13] carried out experiments on a larger scale using a tank 20 ft. diam. with 4 ft. diam. turbine agitators. The tank was fitted with baffles and a sparge ring of the same diam. as the impeller. The results showed that the total power consumption was a minimum

when the oxygen absorption efficiency was in the range 10-20%, which added support to the findings of Kalinske.

For a constant liquid volume, increasing the liquid depth increases the contact time and the efficiency of gas absorption and decreases the volumetric rate of air flow. However, at the same time the required air pressure increases and so does the shaft length of the agitator. Hence, in order to use low-pressure air blowers and for cheapness of construction it is usual to limit the depth of tanks and to use multiple agitators where large volumes have to be handled.

Powder mixing

Several statistical theories of powder mixing have been proposed from time to time and the data available at present are insufficient to define their limits of application.

It is to be expected that the controlling mechanism of particle mixing will vary according to the "action" of the particular design of blender being used, so that different theories may apply for different types of equipment. A readily applicable criterion by means of which the progress of a solids mixing operation can be followed has been derived by Lacey.[14] Based on Fick's law of diffusion, he has deduced that a graph of time against the term

$$\log\left(\frac{S^2}{\sin^2 \pi p}\right)$$

where S = standard deviation of the sample.
p = mean composition of the whole mixture.

will give a straight line for well-mixed particles, any departure from the straight line indicating failure to achieve good blending.

Several standard designs of powder mixer have become established, the principal of them being the ribbon, the double cone, the V or twin-shell mixer and the rotating cube. When the latter designs were introduced it was sometimes assumed that the much older ribbon type trough mixer was superseded. Recent work, however, has shown that each design has its limitations and its range of application and that provided care is taken to secure adequate end-to-end motion of the particles along the trough the ribbon blender can still be a very useful and efficient piece of equipment.

A method of assessing the relative efficiency of different designs of powder mixer has been suggested by Adams and Baker.[15] Polythene consisting of approximately 4 mm. cubes (s.g. 0·92) was mixed with a master batch of 3 mm. cubes (s.g. 1·2) which had been coloured with carbon black. Master batch was added to the natural polythene in the required proportions and the blender rotated for a definite number of turns. From 20 to 30 samples were removed at regular intervals during the blending operation and the number of black particles plotted against the sequence of samples. The number of results lying outside certain limits was then compared with the number to be expected from probability theory. The double cone blender was found to be rather ineffective for this duty because of the specific gravity difference in the materials. Under such conditions the heavier constituent tends to collect in the centre of the material and to be discharged first. This tendency, which is promoted by the symmetrical shape of the mixer, is affected by density, particle size and surface finish. It can be reduced by fitting an internal deflector plate which, however, offsets to some extent the ease of cleaning which is one of the great advantages of this type of blender. The ribbon trough mixers tested did not give efficient end-to-end transfer of material and so gave poor results. The twin-shell blender gave rather better results, but the best mixing of these particular materials was obtained from a cubical blender having an internal paddle arm.

A similar investigation has been reported by Gray,[16] but in this instance a photo-electric method of measuring the degree of mixing was used. The mixers tested were of the double cone, twin-shell, ribbon, drum, muller and planetary types, and three series of runs were made. In the first 91% of sand (s.g. 2·6 mainly 65-200 mesh) was mixed with 9% of ilmenite ore (s.g. 4·3 mostly finer than 200 mesh). After 2,000 turns there was no further improvement in the degree of mixing, and with this considerable difference in densities and particle sizes the ribbon blender gave the closest approach to uniformity of composition. The V-mixer and the muller also gave good results, but the double cone blender was found unsatisfactory, thus confirming the findings of Adams and Baker. The second series of experiments tested the V-mixer and a double cone blender when handling 80% of aluminium oxide (s.g. 4·0) and a grade of ilmenite ore having about the same particle size. Under these conditions the V-mixer gave a more uniform product after 2,000 turns and the standard deviation curve showed that after 100 turns in the double cone blender segregation of the particles started to occur.

The materials used in the final series of runs, namely barium sulphate (mostly finer than 5μ) and ilmenite ore (90% finer than 40μ), had the same specific gravity but different particle size distribution, and they gave a mixture which was not free flowing but tended to form aggregates. The designs tested in this series were the ribbon blender, muller and twin-shell blender. After 2,000 turns the ribbon mixer again gave the most nearly uniform blend, such agglomerates as were formed becoming smaller as the agitation was continued. The curve for the twin-shell mixer is unfortunately not shown beyond 700 rev., at which point the degree of uniformity was intermediate between that of the ribbon mixer and the muller.

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MIXING MACHINES

Construction, Performance, Applications

Mixer/Pasteuriser

Clarke-Built Ltd. supply many types of mixing plant, among them an all-stainless steel mixer/pasteuriser, which is used in liquid heat treating and mixing operations. Cylindrical in shape, it incorporates advanced principles of fast controlled even heating and mixing, for light and heavy-bodied products.

The Clarke-Built pasteuriser/processor has polished stainless steel surfaces, both inside and out. The processing vessel itself has a self-draining base to a flush-mounted outlet valve, and is surrounded by a heating jacket which is insulated and finally clad in polished stainless steel. Fully hinged and removable covers are provided to facilitate inspection and cleaning. The ¾ b.h.p. geared electric motor is mounted horizontally for torque-free operation. Adjustable ball-type feet are fitted to allow for variations in floor level. The heating medium is low-pressure steam, fed into a specially designed jet system, accommodated in the base of the heating jacket, the steam vapour being used for heat transfer. The desired temperature is reached very quickly and can be consistently maintained. Recording thermometers and self-acting steam controllers are supplied as extras to the standard equipment.

The cooling system is provided by a spray-cooling ring, fitted inside the top of the jacket. The cooling medium employed can be brine or chilled water.

The agitator, made of stainless steel, is easily and quickly removed. It is a long-sweep propeller-type, driven from a direct-geared motor. There is also an adjustable baffle, which, through breaking the vortex in the desired position, increases considerably the mixing and processing efficiency of the equipment. This feature contributes to the consistent results regularly achieved.

Particular attention has been given to accessibility of all components to facilitate inspection, cleaning and sterilising.

Capacity range is 100/500 gal.

Paddle-Type Mixer

Manesty Machines Ltd. have re-designed their "H" stainless steel mixer, but its basic principles are retained. Powders or moist masses can be finely mixed and the machine is also suitable for tablet granulation. A powerful geared drive and sturdy paddle deal with difficult ingredients.

The machine consists of a rigid cast-iron cabinet carrying the main spindle sleeve, on the front of which is mounted the overhung stainless steel container. The drive to the paddle is from a 2 h.p. motor mounted on the end of the machine, through vee belts on to the totally enclosed worm and wheel, the wheel shaft then passing through the spindle sleeve and connecting with the stainless steel paddle. The arrangement of the paddle blades gives accurate mixing.

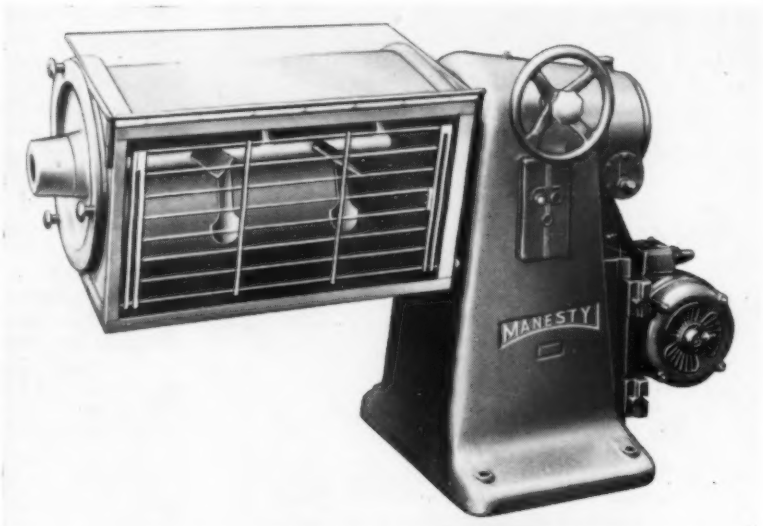
A stainless steel safety guard just inside the container is interlocked so that on opening the motor automatically stops. A transparent plastic dust cover allows the mixing process to be observed and, being hinged, allows solutions to be added through the guard while the mixer is in motion.

A handwheel on the cabinet discharges the powder or granules into a container which can be placed completely under the body.

The worm is of nickel steel, case-hardened and ground on threads, and the worm wheel is of Holfos bronze, both to British Standard specification. The worm wheel and the main spindle sleeve are all mounted on ball bearings of ample size to carry the journal and thrust loads.

The machine has a capacity of approx. 100 lb. of powder. It stands 3 ft. 6 in. high, and occupies 5 ft. 7 in. by 2 ft. 6 in. floor space.

A 200 lb. stainless steel trough mixer will shortly be in production. This will have a removable paddle which is a feature of the 100 lb. "H" mixer, but a different method of fixing will be employed.



Difficult ingredients are dealt with by the powerfully geared drive and sturdy paddle of the re-designed Manesty "H" stainless steel mixer.

Laboratory Machines

Premier Colloid Mills Ltd. supply mixers capable of handling quantities from a few ounces up to 10,000 gallons. They all feature the patent "Dispersator" mixing head, but are also available with either the conventional marine-type propeller or a specially designed turbine mixing head. The "Dispersator" is a drum which rotates at high speed. The resulting centrifugal force impels the product outwards through narrow slots in the wall of the drum. The product is thus sheared twice: once as it passes at high speed through the slots, and again when the columns of liquid emerging from the slots contact the relatively slower moving mass of liquid in the mixing vessel.

The laboratory mixer 1300 has a 1/30th h.p. totally enclosed motor, with variable speed control up to 4,000 r.p.m. incorporated in the machine. The telescopic stand gives vertical and horizontal control, and the mixing head, whether "Dispersator," propeller or cage-breaker, is in stainless steel. The mixer is finished in chrome and acid resisting stove enamel.

The pilot mixer 2300 is capable of

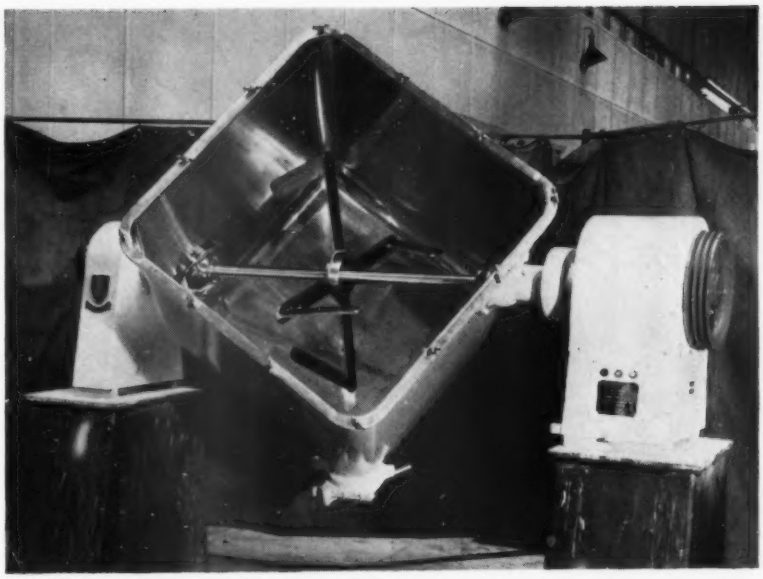
handling more than the laboratory mixer but is still completely portable. It is suitable for small industrial production. It has a totally enclosed ¼ h.p. single phase motor. Mixing heads vary, but there is a specially designed marine-type propeller which fits the neck of standard drum openings, thus dispensing with the need for a mixing tank. It can be clamp mounted, or supplied with heavy-duty telescopic stand for firm floor mounting. Capacity is between 5-50 gal., according to viscosity. It is finished in off-white stove enamel.

The design of the portable "Universal" mixer 2100 is intended to meet the general need for a medium powered mixing unit, built to the same standards as other Premier mixers and having a range of power and speeds to suit most requirements. The basic unit can be supplied in some 25 variations of these two factors, to which can be added variations of shaft length, mixing head and flameproof motor range. The detachable mixer shaft locates in a hollow spindle directly connected to the motor spindle, and the shaft is locked in position by a collet housed in the lower bearing. There is a wall mounted push-button starter and rigid twin-clamp mounting. Capacity ranges from 50 to 1,500 gal., according to viscosity.

Premier's top-entry mixer 3100 is a development of the "Universal" mixer. Construction is the same, but the form of mounting is designed for permanent installation. All specifications are as for the Model 2100.

Their side-entry mixers 3400 and 3600 have, between them, a range of motors up to 7½ h.p. Flameproof motors are optional. All are stated to be completely silent in operation. They have cast iron body castings. Mounting is drilled to suit standard flange. Capacity ranges up to 10,000 gal. They are finished in off-white stove enamel.

Premier Colloid Mill have developed this 6 in. dispersion mill. It has a two speed 5/10 h.p. motor. Output is up to 150 gal/hr. Hopper capacity is 5 gal.



The figure-of-eight action of the Rotocube is particularly effective when an ingredient forms only a minute percentage of the total mix. It is designed by Foster, Yates and Thom Ltd.

Overturning and Interweaving Action

Rotocube dry powder mixing machines provide a new and effective approach to the problem of obtaining a consistently accurate mix when ingredients widely vary in characteristics and proportions.

These machines, developed by Foster, Yates and Thom Ltd. comprise a cube shaped drum mounted diagonally at a compound angle on trunnions and rotated at 10 r.p.m. The resulting action inside the drum prevents the heavier ingredients from accumulating at the bottom of the mix and effects uniform distribution of each constituent, including those that may represent only a minute percentage of the total mix.

Another interesting feature claimed for these machines is the remarkably short mixing time cycle required for obtaining optimum results. This is achieved without causing harm to the ingredients either through attrition or pulverising as the mixing action is not dependent on high speeds for its efficiency. Where necessary impellers can be introduced and these rotate in the same direction as the drum, to combine a gentle "overturning" motion with the "interweaving" action already established.

Among the more important operating advantages offered by this design is the ease with which the drum can be completely discharged and cleaned. Discharge can be effected either by removing the main lid and "inching" the drum into position where two of its sides form a natural chute, or by means of a discharge valve set in the lowest corner of the drum. Cleaning has been simplified by radiusing all internal corners, completely eliminating cavities wherein materials might lodge, and by making provision for the quick removal of the impellers when used.

The main drive of the machine is a low h.p. electric motor driving through "V" ropes, an 80 : 1 heliocentric reduction gear to which the drum is attached by half-couplings. The impeller shaft driving gears are housed at the opposite end of the machine and consist of a driving spur fixed to the end of the drum trunnion, an intermediate compound gear and a driving spur on the impeller shaft. This train produces a speed contrast between the impeller shaft and the drum of approximately 3 : 1. The electric starter is a push button unit, giving "Stop," "Start" and "Inching" control. A process timer, graduated in minute intervals from 0 to 80 min., can be incorporated if required.

Careful attention has been given to the sealing of the various bearings and in particular to those in the

impeller shaft bore of the trunnions. Here, by an arrangement of opposed oil seals and baffle washers, ample protection is provided against the possibility of oil seepage contaminating the mix or fine particles of the mix entering the bearings.

Models are available for laboratory and production purposes with charging capacities ranging from 10 to 1,600 lb. They can be supplied with the drums and impellers manufactured from mild steel, stainless steel or aluminium, and can be either in transportable form or suitable for mounting in a fixed position on foundation columns. The machines are finished in cream and black cellulose, and chromium plate, which serve to emphasise the modern clean lines of the design and at the same time provide an easy-to-clean surface.

65-Gallon Mixer

The demand for a very large capacity mixing machine led James Cruickshank Ltd. to design and construct the *Giant* vertical mixer which is now available with a bowl capacity of up to 65 imperial gal.

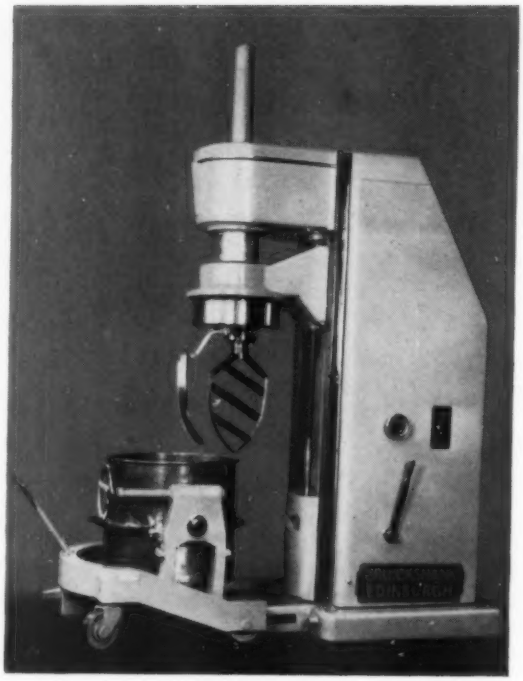
Although the *Giant* is a standard vertical machine, employing the well-known planetary action, it is built only to individual order. The all-up weight of this machine is over 2 tons, and it stands 10 ft. high.

The main frame is a single fabrication being ½ in. and thicker steel plate, while the fixed and moving gear heads are castings. All-electric motors, control equipment and gearing are enclosed within the main column, although access for servicing and inspection is available through a large side door.

Being "custom-built" most of the other features of the machine are to customers' choice, but many now have been adopted as standard. The main drive of the machine can be offered in single-speed, 2-speed, through pole changing electric motor, or for complete coverage a 9-1 ratio variable speed gear coupled directly to the electric motor. Clutch control is provided to avoid motors being started on load. The raising and lowering of the mixing head is operated by an independent electric motor. This, like the main motor, is operated by push-buttons mounted on a control panel.

Moving parts are interlocked by limit switches for both personal and mechanical safety.

Cruickshank provide mixing equipment and appliances in various designs to suit the customers' needs. Bowl scraping can be incorporated into the mixing head. The head lowers into the mixing bowl and when it is raised all the mixing appliances and scraper are completely withdrawn. The needs of the chemical and pharmaceutical trades, particularly in regard to hygiene and cleanliness, are well covered in that a full range of mixing appliances and bowls is available in stainless steel, but the manufacturers are also able to offer all these items in other metals or alloys, or with various coatings.



Built to individual requirements, the Cruickshank vertical mixer is available with a bowl capacity of up to 65 imperial gallons.

The mixing bowls themselves are fully portable, and accurately located on the machine where interchangeability is assured. Any number of bowls can be supplied for operation in the machine, based on production requirements. Tipping devices are available to empty the bowls. Other notable refinements include full or half jackets to the mixing bowls for the introduction of heating or cooling mediums, and it is also possible to incorporate a suitable hood or canopy to completely enclose the bowl contents during mixing operation.

The machines are used for the preparation of ointments, compounds, pastes, fluids and semi-fluids, and also for dry powder mixing.

Uni-rotor Mixer

A uni-rotor has been built by Baker Perkins Ltd. in collaboration with the British Rubber Producers' Research Association. It has been used for some years in the laboratories of the B.R.P.R.A. to meet the requirements of research studies and the handling of small amounts of experimental materials. Now special mixing chambers have been added to make this machine suitable for small-scale mixing operations.

The heavy ingredients are contained in a cup-like chamber and are mixed by a rotating twisted blade. The shape of the rotor and grooving of the chamber urges the material to the closed end of the chamber as well as moving it laterally to give efficient mixing. This arrangement allows up to 1 h.p. input per gramme of material. There is no tendency for materials to escape from the open end of the chamber.

The smallest mixing chamber provides efficient mixing of 2 to 10 grammes of material. The next size overlaps this range and operates with up to 50 grammes of material. The large variability of charge over a five-fold ratio is one useful feature. Another is the short time, 1 min. or less, required for loading and unloading.

The efficiency for breakdown of the rubber can be varied to include within its range the normal breakdown experienced with production machines. The conical chamber gives a wide variation of efficiency of breakdown by simply raising the rotor and consequently increasing rotor/chamber clearances.

For temperature control in the laboratory the mixing chamber is normally immersed in a liquid, or water-steam jackets are fitted. Unlike industrial mixers and their scaled-down counterparts, the temperature of the material being mixed can be kept constant to within 1 or 2 degrees.

Mixing efficiency for rubbers has been tested by mixing vulcanising ingredients with smoked sheet. Within 1 to 5 min., depending upon temperature, all the vulcanising ingredients can be incorporated and dispersed

uniformly, as has been shown by uniform swelling of the vulcanizates prepared from the compounded stock. Thinners and rubber are said to have been likewise mixed satisfactorily. Similarly, efficient mixing is obtained with plastic materials mixed at temperatures at which they are rubbery; for example, polystyrene with a dye at 130°C. gives a product of constant colour throughout, as determined spectrophotometrically.

Other designs of chamber and rotor are variable for special purposes. Spiral-scroll types have been employed in the classical studies at B.R.P.R.A. to elucidate the mechanism of cold mastication, and are of use in cases where shear without good mixing is required. The plough-scroll type provides even greater breakdown than the spirals and at the same time gives good mixing.

Giant Mixers

In recent years there has been a considerable increase in the size and capacity of mixing machines. A few years ago it was usual to mix a large number of small batches. Now it is quite common to mix quantities of 10, 15 or 20 tons at a time. As an example of this William Gardner and Sons (Gloucester) Ltd. are constructing drum mixers 21 ft. long by 12 ft. dia. for the chemical industry and a 14 ft. dia. stainless steel double cone mixer for the plastics industry.

The double cone mixer has become a very popular type by virtue of its simplicity and because of its anti-attrition properties when dealing with materials which could be broken down in other types of mixers.

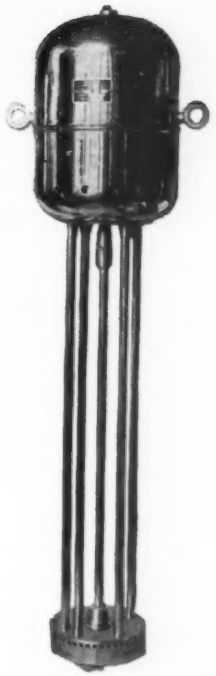
Multi-Purpose Mixer

The Silverson multi-purpose machine consists basically of a powerful centrifugal pattern suction pump, enclosed in interchangeable heads. The rotor blades in the standard machines revolve at 2,800 r.p.m., and subject the liquid being mixed to an intense high velocity shearing action.

The machines are individually manufactured in stainless steel.

The Silverson machine is unusually versatile as it allows the operator to control its action on the mix. Simply by changing the head of the mixer or inserting an emulsor screen the action of the stirrer can be modified and controlled to give optimum processing.

The standard head allows the mix to be sucked in at the bottom and projected in a horizontal plane at high velocity. This head is used if the quantity of liquid being mixed is small in relation to the size of the vessel, such as a premix in a small container, or if there is a shallow depth of liquid in a large mixing vessel, such as an early stage in a mixing process. All heads of the machines can be changed quickly without tools.



Silverson multi-purpose machine.

In a vessel with a " dished " bottom, when the stirrer head is placed low in the vessel, the shape of the bottom deflects the liquid up the sides of the vessel towards the surface, creating an inward circular mixing current complementary to the intense action which occurs in the head.

Placing the head near the surface of the liquid causes the mix to be projected in a horizontal plane to the sides of the vessel, and thence down the sides of the mixer, creating an outward circular mixing current, which may be more suitable for certain purposes.

The heads of the stirrers can be placed in any position to achieve a desired result.

This 14 ft. double cone mixer, which weighs over 28 tons, is thought to be the largest of its kind ever made. It will be exhibited by Wm. Gardner and Sons (Gloucester) Ltd. at the forthcoming Chemical and Petroleum Engineering Exhibition in London.

The axial flow head projects the liquid vertically up the shaft of the stirrer towards the surface of the mix, and circulates outwards and down the sides of the vessel.

This type of head is particularly useful where there is an appreciable depth of liquid to be mixed, and where the vessel in which it is contained is not well shaped to assist mixing, such as a deep container where the shape does not assist the mixing action. It is especially useful for preventing an insoluble powder from settling on the bottom, and keeping it evenly distributed throughout the mass.

This head is very suitable for distributing heavy liquids which tend to sink to the bottom of the pan, as they can be forcibly projected towards the surface of the liquid to assist solution or a reaction to take place.

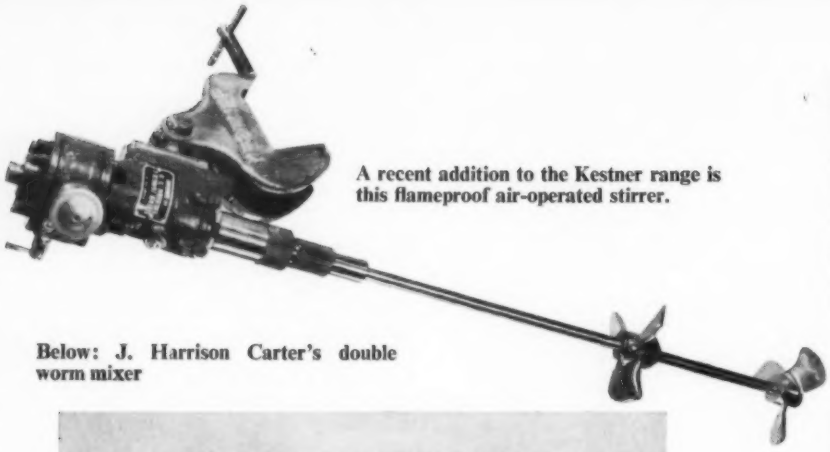
In certain instances, freedom from aeration is most important, and for this purpose the axial flow head is ideal. This head projects the liquid vertically up the shaft of the stirrer, so preventing vortex formation, with the subsequent entrapping of air.

Circular emulsor meshes are available for inserting into either of the types of head, and only one is needed to fit all the heads of a stirrer. These meshes are fitted within a fraction of an inch of the high-speed rotors, and greatly increase the shearing action, as the liquid is forced tangentially through the mesh at high velocity before it can leave the head. These meshes can greatly assist processing by causing the breakdown of agglomerates into a discrete particulate form. In addition, they can remove oversize particles, and certain extraneous matter so that homogeneous dispersions and emulsions are produced in a very short time.

The pumping head adds to the versatility of the machine. It consists of one or more outlets to which can be attached lengths of hose so that after processing the liquid can be pumped away from the mixing pan to storage, providing a pressure of less than 16 p.s.i. is adequate. The pumping rate is fast, the machines are self-priming, are non-pulsating, and even the stirrers of motors of less than 1 h.p. will pump at the rate of several hundred gallons per hour. As the pumping action is centrifugal and non-positive it is very useful in conjunction with a filter which will operate at low pressures.

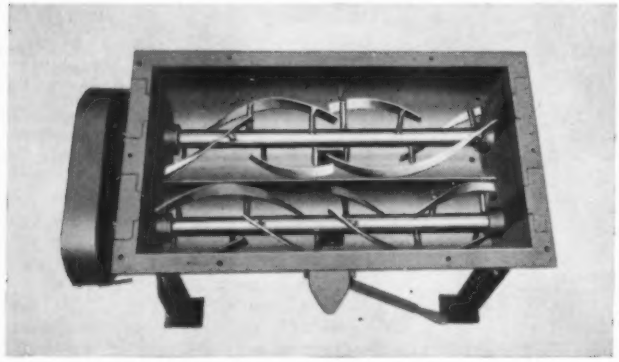
It can be also used to fill a small or large container or bottles, etc., where the flow is continually interrupted, and is also useful for pumping the product to storage containers or filling machine hoppers.

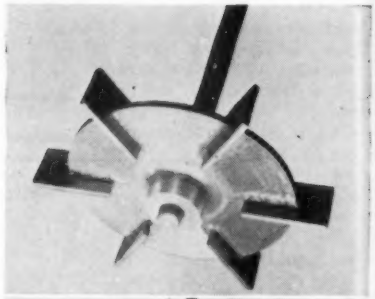
The stirrer is normally suspended when in use, as this gives greater control over the precise positioning in the mix. With the smaller stirrers

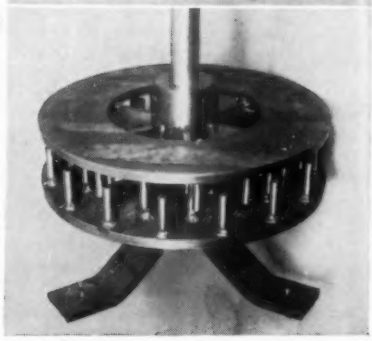


A recent addition to the Kestner range is this flameproof air-operated stirrer.

Below: J. Harrison Carter's double worm mixer







The 6-bladed turbo impeller (above) and the rotor stator type units (below) are made by L. A. Mitchell Ltd.

the usefulness is often enhanced if the stirrer is suspended on a stand which can be moved from pan to pan as required, and can also be held by the hand.

In addition the stand allows the stirrer to be freely positioned at the will of the operator so that optimum mixing position is obtained at all times. The stirrer can be re-positioned in the mix without the necessity of stopping it.

Large mobile floor stands are available for machines up to 7 h.p.

Machines ranging from 7 h.p. to 25 h.p. require special fixing.

Double Worm Mixer

J. Harrison Carter have designed the double worm mixer for blending and mixing granular or powdered materials. The machine is made of black sheet or stainless steel and for certain processes can be either water or steam jacketed.

The machine consists of two U-shaped troughs each of which has two ribbon-type scrolls mixing the ingredients in three directions along the whole length of the troughs. A differential prevents the two sets of scrolls from running at the same speed. This method gives a blend superior to that of the single trough mixer also made by the firm. This is useful for the simple mixing of granular and powdered materials and it can also be used for mixing in of liquids such as oil, spirit or water to the ingredients.

Various forms of rotating centres can be supplied, depending on the material to be dealt with and the operation required. When cooling or heating of the product is required during the mixing operation the trough can be supplied with suitable steam or water jacket.

Impeller Improvements

The main developments in mixing techniques over recent years have been in connection with the impeller design rather than the drive unit itself, and L. A. Mitchell Ltd. have made available a range of mixing heads for all process requirements.

While it has previously been common practice for propeller and paddle type mixers to be applied extensively, it is becoming increasingly necessary to assess each mixing problem on its merits with a view to supplying equipment of size, speed and impeller type best suited for the duties in question. Although there has been little change in design of propeller and paddle type equipment, there have been many variations in the turbine range.

For providing a more vigorous form of agitation than that given by propellers, the six-bladed turbo impeller is recommended, particularly when used in conjunction with suitable vessel baffles. The open turbo impeller is specially designed for handling heavy suspensions, slurries, etc. Generally speaking, power input requirements are somewhat larger than those of propeller type mixers, but process times are reduced.

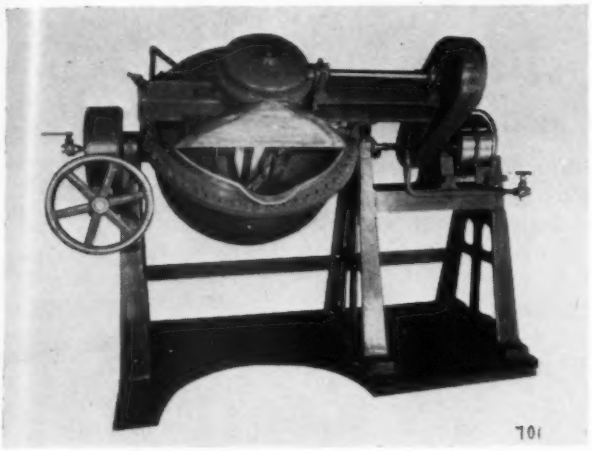
From the basic turbo impeller many variations have been developed. When top and bottom shrouds are added a more intimate form of mixing takes place during the contact period within the device. Again a further development of the simple type turbine is the rotor and stator type unit. This is in principle similar to an open turbine with close-clearance baffles. Rotor and stator type units can be provided in two forms:

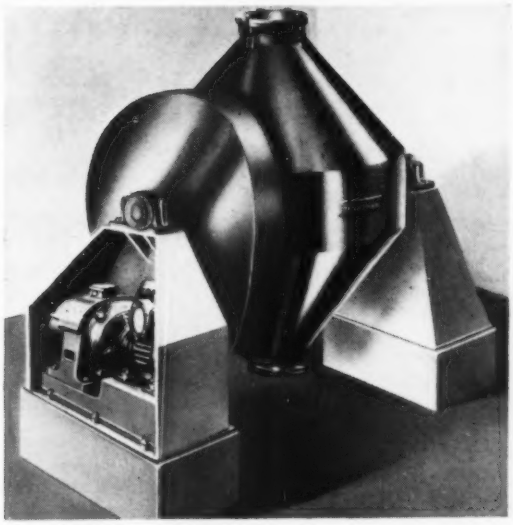
1. with circular open type stator rings, which prevent agglomeration of particles which may otherwise tend to build up; and
2. with shear edge stator ring (or rings) which has a square section of stator pin so designed that a maximum shear is imparted to the material as it is discharged radially from the top of the impeller.

An interesting type of turbine head which avoids the mechanical complication of rotor and stator combination is the emulsification disc. Whilst emulsification is normally achieved by means of a homogeniser, this type of disc gives excellent results on certain combinations of fluids which readily emulsify. The disc provides a large shear area and the cutting action of the sharp edges of the high speed vanes ensures that an intensive shearing action is applied.

The above impellers can be used for batch or continuous processes, and the turbine device is usually applied for continuous mixing processes of the " in line " or multi-stage types.

William Brierley, Collier and Hartley Ltd. have developed this stainless steel mixing pan. It is fitted with stirrers which continue to revolve while the pan is being tilted for emptying.





Steel-Shaw "Oblicone."

Air Operated Stirrer

An air operated stirrer has been added to the range of portable type stirrers made by Kestner. It is additional to those operated by a totally enclosed or flameproof type of electric motor. It is completely flameproof, the prime mover being a rotary vane air motor suitable for working pressures of up to 90 p.s.i. with integral sun and planet reduction gear driving a stainless steel, or plastic coated, shaft which is fitted with two opposed propellers. Small size and light weight are among its advantages over the conventional totally enclosed electric motor. It also has a flexibility through the air control fitted which provides variable speed operation. As with Kestner's other stirrers, an adjustable bracket and mounting clamp is provided for direct attachment to the rim of the mixing vessel.

Pan Stirrers

Cosmetic and toilet creams are among the products that can be mixed in machines made by William Brierley, Collier and Hartley Ltd. These are available in every size from ½ gal. up to 60 gal. They consist of a stainless steel jacketed pan fitted with stainless steel stirrers. The stirrers can be designed to continue revolving while the pan tilts for emptying. The mixers can be supplied with hydraulic drive if required.

Vertical machines in which medical products can be mixed are also made by the company. These consist of a stainless steel pan which can be single cased or jacketed. The stirring arms are stainless and arranged with 1 mm. clearance between each other to ensure a thorough mix. The machines can be supplied for individual motor drive and are offered in various sizes from ¾ cwt. to 3 cwt.

Shakers and Blenders

Steele and Cowlishaw Ltd. have recently introduced three types of mixing machinery for the pharmaceutical and chemical manufacturing trades—the Steel-Shaw *Quickway* shaking machine, the *Oblicone* blender and the *Diamond* blender.

The *Quickway* shaker was designed originally for restoring settled-out paint to its original consistency. It has been found suitable for mixing small quantities of powders and liquids in jars or containers which are easily clamped in the adjustable container holder. It has a vigorous dual reciprocating oscillating motion with 1,400 agitations per min. Model "A" is for containers of ¼ pint to 1 quart capacity and retails at £42; model "B" is for containers of 1 quart to 1 gal. capacity and retails at £58.

The *Oblicone* blender is designed for the rapid blending of free-flowing solids ranging in particle size from fine mesh powder to large pebbles. The obliquely set cones impart to the contents a combined gyratory and tumbling motion at each spin of the drum. The cyclic variation in cone angles also permits a wide range of materials with different "angles of repose" to be processed in the same machine. The movement of these conical shapes ensures that all the particles of material being blended follow a different trajectory, resulting in a complete and uniform blend.

The *Diamond* blender, though designed for the same work as the *Oblicone*, gives different movement to the particles being processed. At each revolution of the diamond unit the material being blended is divided into twin streams which cascade into the lower half of the unit, where they are brought together again at the bottom of the diamond. The action is repeated twice with each revolution. A further mixing movement is achieved by the diagonal setting of the diamond in relation to the driving axis giving the materials being blended a slow spiral circulation around the four tubular members of the unit.

Though both blending machines are made in sizes from a laboratory model to large industrial units, they can also be "custom made."

Hand Blender

The hand operated Flexiblender is a development of Eukrater (Sales) Ltd. for the bulk handling of pharmaceuticals. It employs the principle of reciprocal displacement within fluid bulk to produce an instantaneous high degree of turbulence. It has no inherent tendency to rotate, thereby eliminating centrifugal separation. It will function within a W/M Winchester.

This method of blending is claimed to produce uniform dispersions, suspensions and solutions with or without aeration, according to the technique employed. Its construction allows it to be applied to any practicable volume of liquid mix regardless of cross-section area or depth. A conduit system for heating and cooling and the introduction of fluid reactants, uniformly into bulk liquids, during the blending process offers a critical mixing control. Permanent magnetic scavenging and electric heating elements may be incorporated.

Its overall length is 15½ in.; its hub, when folded, is 1 in. diam. and when extended and locked 4½ in. diam. It can be easily dismantled for cleaning. Power operated models are available.

Germicides Based on Surface-Active Agents

FURTHER STUDIES

By C. D. Moore,* F.R.I.C., and R. B. Hardwick,* B.SC., A.R.I.C.

The authors' first article on this subject appeared in our August 1956 issue. Here they describe the nature and activity of further classes of surface-active agents with particular reference to products recently introduced commercially or still in the development stage.

SURFACE-ACTIVE AGENTS

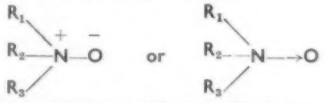
Alkylolamides. The products under discussion are obtained by condensation of fatty acids, usually lauric or homologues, with diethanolamine, or similar compounds, according to the original patent of Kritschevsky,[1] the ratio of amine to fatty acid being not less than 2 mols. of amine to 1 mol. of fatty acid. The condensation being terminated when the reaction mixture contains 5-6% fatty acid, the latter is present as an amine soap. This type of product will clearly be a highly complex mixture, containing amide, amino ester and various other condensation products, together with amine soap and free amine. For the functioning of this type of product, the presence of the amine soap is essential, and they have actually been termed enhanced soaps by Valko.[2] From first impressions it would be expected that this type would at the most be only dispersible in water, and the phenomenon of solubility in this class of product has been very aptly termed by Valko comicellisation.

Comicellisation may be described as the orientation into micelles of a randomly distributed mixture of soluble and insoluble materials, whereby the polar heads, *e.g.* (OH, COOH.), present maximum surface area to the aqueous phase, thereby an optimum configuration for solubility is obtained. The derivatives of compounds of C_{14} and less are sufficiently soluble in water to be useful as detergents, etc., but those above C_{14} are not sufficiently soluble to be used as the main component of a mixture. This is due to the hydrophile/lipophile balance becoming unfavourable because of the rather critical lack of polarity of the micelles. The phenomenon of comicellisation is probably of quite common occurrence and not limited to any one class of surface-active agent. This type of agent is compatible with quaternary ammonium compounds and phenols, provided that solubilisation occurs, with a minimum of amine soap, an important factor to consider as many commercial materials contain, for various reasons, excessively large amounts of amine soap.

* Glovers (Chemicals) Ltd.

Cationics

Amine oxides. These products have the general formula,



where R_1R_2 and R_3 are alkyl groups and the sum of $R_1R_2R_3$ is generally upward of 15.

This type of compound is one of the earliest examples of a compound containing a semi-polar linkage. Amine oxides appear to be primarily soluble due to solvation by hydrogen bonding of water, and if any of the alternative form, *i.e.*

$$[R_3N{-}OH.]^+ OH^-$$

is present, the amount must be very small, as the aqueous solution is virtually neutral in reaction.

The salts of these compounds, however, show a strongly acid reaction in solution, and they have been formulated thus:

$$[R_3N{-}OH]^+ X^-$$

From the above it is clear that the products are cation active, and as a class they possess the same advantages and disadvantages as quaternary ammonium compounds, *e.g.* inactivation by anionics, etc.

No published information is available giving the bactericidal levels for an homologous series of amine oxides against the more resistant Gram-negative organisms, an essential requirement for the formulation of a germicide. The authors hope to be able to provide this desirable information at some later date.

Non-ionics

The recent introduction of non-ionic surface-active agents based on polypropylene glycols condensed with ethylene-oxide, has provided additional materials useful in combination with Q.A. compounds and as agents for the solubilisation of iodine. For practical purposes they may be considered as behaving like any other non-ionic surface-active agent.

The constitution of non-ionic surface-active agents, in aqueous solution, is still open to question. Mulley and Metcalfe[3] have contributed further evidence for hydrogen bonding of phenols to the ether oxygens in non-ionics. The evidence obtained spectrographically was, however, not of a quantitative nature, but these workers were of the opinion that hydrogen bonding predominates.[4] Work of this nature is likely to verify or disprove the opinion of Wurzschmitt, that an equilibrium exists between the oxonium type of compound and that formed by hydrogen bonding. Present theories of the nature of these compounds in aqueous solution can be represented thus:

hydrogen bonding$\rightleftharpoons$oxonium compounds,

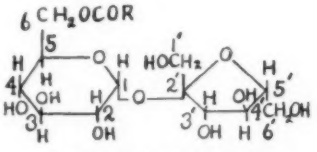
hydrogen bonding predominating in those adducts formed from compounds of low acidic strength and the oxonium type of compounds from those of greater acidic strength. Provided the hydrophile/lipophile balance is comparable in any series, it is likely that those complexes formed in which hydrogen bonding predominates, *e.g.* with a non-ionic

and weakly acidic phenol, will be evidenced by a reduction in the temperature coefficient of solubility, whereas those complexes in which oxonium derivatives largely predominate, *e.g.* mineral acids and strong acidic phenols, such as picric acid, will lead to an increase in the temperature coefficient of solubility.

Fortunately, however, these speculations do not, for practical purposes, alter the view of considering non-ionic surface-active agents as non-ionic except in the rare cases where difficulties may arise when they are considered as being truly non-ionic.

Sugar esters

This new class of non-ionic surface-active agent is the result of work sponsored by the Sugar Research Foundation. (See the article by H. B. Hass in MANUFACTURING CHEMIST, April 1956.) The sucrose monoesters have been shown by Yorke *et al.*[5] to have the ester grouping attached mainly to position 6 in the sucrose molecule, and it is highly probable that in the diesters the other acyl group enters primarily the 6′ position.



SUCROSE MONOESTERS

The interesting feature of this type of agent is that, unlike the normally available non-ionics, solubility is not conferred by a multiplicity of ether groups, but principally by hydroxyl groups; the ether linkages in the Haworth formula for sugar do not behave as they do in a normal ether. From this it can be inferred that phenols should not be readily inactivated as is the case with polyglycol ethers. Experimental evidence has confirmed the above supposition. Sugar esters are also compatible with quaternary ammonium compounds.

Ampholytic surface-active agents

This class of surface-active agent has been known for some time, but their commercial production has been retarded, due entirely to the cost and lack of suitable starting materials. This position is now changing, and it requires little imagination to forecast the ultimate importance of these materials. The theoretical number of possible ampholytes is legion, but broadly they fall into two classes.

(a) **Long chain N substituted amino acids.** These products have the general formula—

$$RNH(CH_2)n.\ COOH$$

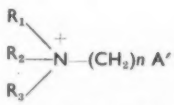
where n is usually 1, 2 or 3, and R is a long chain alkyl or substituted alkyl group. They possess both acidic and basic groups, and thus the behaviour of their aqueous solutions will depend upon the *p*H of the solution. In acidic solution they behave in the cationic form and under basic conditions predominantly in the anionic form. At the isoelectric point both ions are present in equal amounts, and the solutions are effectively neutral in the case of balanced amino acids, *i.e.* where acidic and basic groups are numerically equal. Assuming the free amino acid exists as a zwitterion when $n = 1$ or 2, the changes may be represented thus—

$$\overset{+}{R}NH_2(CH_2)nCOOH \xleftrightarrow{\text{Acid pH}} \overset{+}{R}NH_2(CH_2)nCOO' \xrightarrow{\text{Basic pH}} RNH(CH_2)nCOO'$$

The solubility of this type of compound is at a minimum at the isoelectric point. Unbalanced amino acids, *i.e.* where the acidic and basic groups are unequal in number, exhibit behaviour in accordance with the quantitatively predominant group. In our laboratory many balanced and unbalanced N substituted long chain amino acids have been prepared and investigated, but in the present article only the β - n - alkylaminopropionates will be described as they give an indication of the general properties of this class of compound. The properties of long chain β-n-alkyl aminopropionates have been described by Anderson *et al.*[6,7]

β-n- alkylaminopropionates. As the *p*H of the solution is an all-important factor governing the behaviour of this type of compound, it would be expected that, provided they are of correct chain length, they would function as bactericides in their own right at an acid *p*H; this has been confirmed experimentally. At the isoelectric point little antibacterial activity is observed, and when present in alkaline solution they tend to show the weak antibacterial activity associated with anion active agents. This type of ampholyte is compatible with both quaternary ammonium compounds and phenols. The β alkylamino-propionates do not form precipitates with the normal type of quaternary ammonium compound and this fact enabled us to investigate what is thought to be a common point of error, in that it is generally believed that the inactivation of a quaternary ammonium compound by not less than a molar quantity of an anionic is due solely to precipitation and removal from the aqueous phase. For various reasons it was felt that even if a water-soluble derivative of a quaternary ammonium compound and a fatty acid could be prepared, it still would not show antibacterial activity. Verification of the above was obtained by the preparation of hexadecyltrimethyl ammonium β - n - dodecylaminopropionate, and it was found that this compound, in spite of its high mol. wt., was quite soluble but did not show any antibacterial activity. From the above experiment it was concluded that inactivation is brought about by ion exchange and is not merely due to removal from the aqueous phase. For use in the formulation of germicides, it is highly probable that the aminopropionates will be generally used in the anionic form. As long chain amino acids might well appear among the principal constituents of heavy duty detergent sanitisers, it is encouraging to note that compounds of this type can be prepared having both high foaming and excellent cleansing power, together with virtually complete resistance to hard water.

(*b*) **Betaines.** These compounds have the general structural formula—



where n is usually 1 or 2, R is a long chain alkyl group, and R_2R_3 are small alkyl groups or together form part of a ring system, and A is an acidic group, usually COO′, but it can also be SO'_3 or a similar group. Betaines can be considered as being internal quaternary ammonium compounds and are also analogous to the zwitterionic form of amino acids. The properties of betaines in aqueous solution are, like amino acids, dependent upon the *p*H. However, one important point of

difference between them is that betaines retain high solubility throughout the entire *p*H range, and do not possess a region of low solubility at or near the IEP. Betaines are thus particularly useful in neutral solutions. In acid solution they are present in the cationic form and, in effect, behave like quaternary ammonium compounds, but at the IEP they possess less antibacterial activity, and in basic solution the usual slight activity associated with anionic surface-active agents is observed. Depending on the chain length, they possess high foaming and detergent power, together with a marked resistance towards hard water. Betaines are compatible with quaternary ammonium compounds and phenols. It is believed that mixtures of betaines and phenols behave as if the two form a salt, in spite of the weak acidic nature of the phenol.

The practical results obtained with various combinations of the materials dealt with earlier will now be discussed. With regard to the accompanying graphs it is the shape of the curves which are of interest and not the value of the ordinate, as these values vary enormously with the virility of the organisms of the same species. In all graphs the minimum lethal concentration refers to that of the active material and not to that of the mixture. The Q.A. compound used in all cases was Cetrimide B.P.

Mixture	*Minimum lethal Concentration at* ·001%	·01%	·1%	·5%	1%	2%
A	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6
B	1 in 1×10^6	1 in 5×10^5	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6
C	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 1×10^6	1 in 5×10^5	1 in 1×10^5

A = 75% *Nonionic* / 25% *Na. Dodecylaminopropionate*
B = 50% „ / 50% „ „
C = 25% „ / 75% „ „

GERMICIDAL ACTIVITY

Anionics

Q.A. compounds—alkanolamides. Fig. 1 illustrates the behaviour of combinations of Q.A. compounds and alkanolamides. The alkanolamides were of the type in which the principal constituent is derived from lauric acid and contained 6% free fatty acid in the form of a soap. The organism used was *Ps. fluorescens*, a strongly Gram-negative organism. From the shape of this curve it appears that two opposing factors are in operation. At first there is a very marked increase in antibacterial activity due to reduction of interfacial tension. The initial effect, however, is increasingly offset by the quantity of soap required for solubility, which tends to inactivate the quaternary ammonium compound. As the killing dilution of the Q.A. alone against the organism was found to be 1 part in 7,500, it is clear that one can use up to five times the amount of alkanolamide before activity is reduced to the original level. The use of alkanolamides in combination with Q.A. compounds is particularly valuable because the presence of the Q.A. compound tends to reduce the solubility sensitivity to added fatty material, *e.g.* perfumery, essential oils, etc.; this is also true of the addition of the non-ionic surface-active agents. The latter products would tend to move the peaks in the curves along the abscissæ. Alkanolamides of the above types also appear to be compatible with phenols. It was found that P.C.M.C. in conjunction with lauric alkanolamide showed antibacterial activity at least as high as that of the original phenol alone, at ratios of alkanolamide to phenol of 1 : 1 and 10 : 1. The alkanolamides are a type of produc twhich have not yet received proper consideration as major components of germicidal preparations.

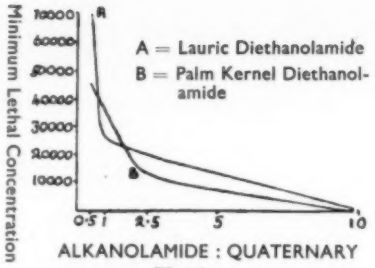


Fig. 1.

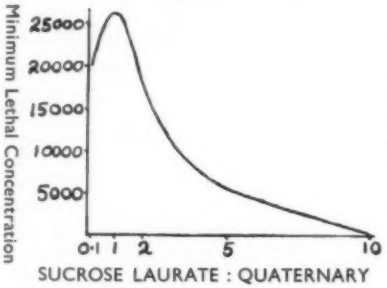


Fig. 2.

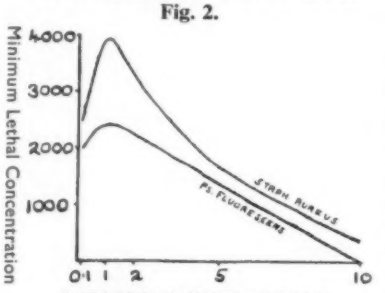


Fig. 3.

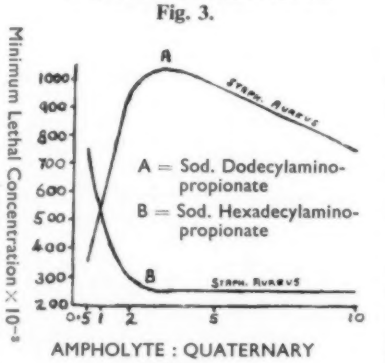


Fig. 4.

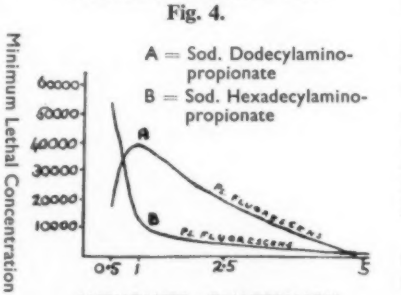


Fig. 5.

Non-ionics

Quaternary ammonium compounds—polypropylene glycol, ethylene oxide condensates. The product examined was a polypropylene glycol/ethylene oxide condensation compound, in which the polypropylene glycol had a molecular weight of 1500 and was combined with 100% of its weight of ethylene oxide. Results showed that for all practical purposes they can be considered as behaving in the same manner as a normal type of water-soluble, non-ionic surface-active agent. (See Figs. 2 & 3, Pt. 1 this journal, August 1956.)

Amine oxides and non-ionics. Because of the limitations referred to previously, *i.e.* lack of information on the amine oxides, all that can be said at present is that curves appear to follow broadly the same pattern as that of normal Q.A. compounds in conjunction with a non-ionic.

Sugar esters and quaternary ammonium compounds. Fig. 2 shows the behaviour of a sugar ester-quaternary ammonium mixture against the Gram-negative or-

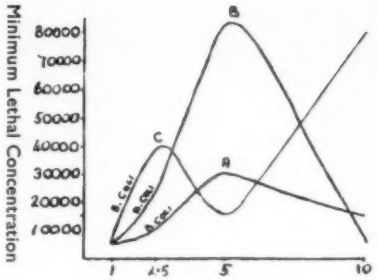
ganism *Ps. fluorescens*. It will be observed that this curve is completely analogous to those previously shown for the polyether type of non-ionic/Q.A. mixtures, and further, the behaviour of this mixture against ther Gam-positive *Staph. aureus* gave the expected results, *i.e.* similarity to ordinary non-ionics.

Sugar esters and phenols. The behaviour of sucrose non-ionics with phenols is illustrated in Fig. 3. The curves show the effect of fixed ratios of sucrose monolaurate to parachlorometacresol against *Staph. aureus* and *Ps. fluorescens*. The results obtained are akin to those using soaps as the phenol carrier and quite unlike polyether non-ionics in which immediate inactivation takes place. As the activity of PCMC alone against the organisms used was 1 : 1500, it will be noted that the phenol in this particular case will tolerate about five times its weight of sucrose ester before loss of activity begins, and this appears to be almost entirely due to micellular incorporation and not to hydrogen bonding and allied effects.

Ampholytics

Quaternary ammonium compounds and aminopropionates. Figs. 4 and 5 illustrate the behaviour of Q.A. compounds with sodium dodecylaminopropionate and sodium hexadecylaminopropionate against *Staph. aureus* and *Ps. fluorescens*.

Against *Staph. aureus* the more strongly micellular hexadecyl compound tends to show a slight deactivation of the Q.A. compound, whereas the antibacterial activity of the quaternary ammonium/sodium dodecylaminopropionate mixture is tending to increase. As Gram-negative organisms are more resistant to the action of Q.A. compounds, the effect of the deactivation of the Q.A. compound by micellular incorporation would be expected to occur earlier than with Gram-positive organisms. The shape of the curve using *Ps. fluorescens* tends to support this opinion. Over the ratios covered, considerable activation occurs in the early part of the curve, falling later to zero at a ratio of 5 : 1. There is a similarity between the shape of the curves given for the same mixtures against both Gram-positive and -negative organisms, the difference being only in the value of the ordinate. As the organisms



A = 75% Non-ionic /25% Na Dodecylamino-
B = 50% „ /50% „ propionate
C = 25% „ /75% „

Fig. 6.

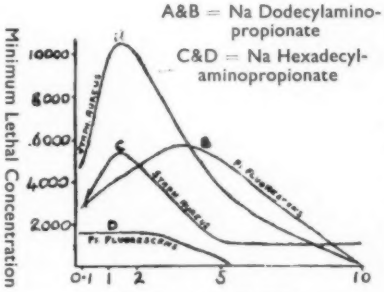


Fig. 7.

used represent, roughly speaking, the extremes of the bacterial spectrum, it would be expected that curves for other organisms would be similar in shape and lie between these two extremes.

Quaternary ammonium compounds, non-ionics and ampholytics. It was considered that the use of non-ionic surface-active agents in conjunction with long chain Q.A. compounds and ampholytics may be desirable from both the practical and commercial angles. At the same time it might well be a means of countering the rather rapid deactivation of the Q.A. compounds by the alkylamino acid salts with respect to the Gram-negative organisms. The effects of a ternary system of this type would, in the present state of knowledge, be difficult to predict. The figures in the table indicate the minimum lethal concentration of Q.A. compound in relation to fixed concentrations of non-ionic plus ampholyte against *Staph. aureus*. The interesting feature is the maintenance of high antibacterial activity in the presence of such a high concentration of surface-active agent. This seems to confirm the opinion put forward previously of the weakly cationic behaviour of non-ionic surface-active agents towards anionic surface-active agents, in that in certain cases they seem to nullify each other's effect. This does not, however, explain why high concentrations of these mixtures should not deactivate the quaternary ammonium compound on account of the high micellular concentration. It is wondered whether in this mixture factors are operating which tend to suppress the anion active part of the amino acid salt so that it makes some contribution to the antibacterial activity by acting in a cationic form. The observed effect seems to be peculiar to ternary mixtures, and apparently due to the bulk effect of the whole. Some such reasoning seems to be necessary in order to explain the maintained high activity in the presence of so high a concentration of micelles. The graph in Fig. 6 shows the effect of fixed ratios of quaternary ammonium compounds to a predetermined mixture of sodium dodecylaminopropionate and non-ionic surface-active agent. In this case the organism was *B. coli*. It can be seen from the curve that the addition of non-ionics to the ampholytic/Q.A. compound mixtures can have the desirable effect of extending the region of antibacterial activity against Gram-negative organisms, which, generally speaking, is the factor controlling the potency of antibacterial preparations. The question may be raised why there is a prolongation of activity due to the bulk effect against the Gram-positive organism, but not against the Gram-negative organism. The answer is no doubt due to the fact that the Gram-positive organisms are ultra-sensitive to the mixture, whereas Gram-negative organisms require products of higher intrinsic antibacterial activity.

Phenols and alkylamino acids. Experiments carried out with mixtures of P.C.M.C. and the sodium salts of dodecylamino and hexadecylaminopropionic acids (Fig. 7) gave the expected result by analogy with ordinary soaps. The familiar pattern of activation followed by deactivation at high ratios of surface-active agent was observed, except in the case of the sodium hexadecylaminopropionate/P.C.M.C. mixture against *Ps.*

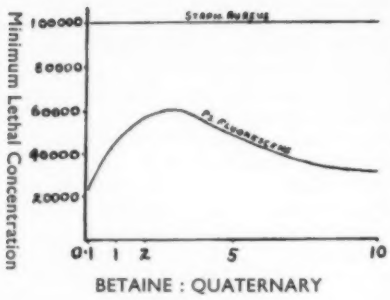


Fig. 8.

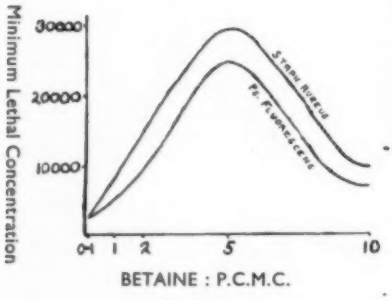


Fig. 9.

fluorescens, which did not show any activation. This is thought to be due to solubility effects and not to any deviation from the general pattern. The original antibacterial activity of the P.C.M.C. against the particular cultures of Gram-positive and Gram-negative organisms was 1 in 1,500. It must be remembered that because of the differing mode of action the difference in activity of phenols against Gram-positive and Gram-negative organisms is not nearly so marked as with quaternary ammonium compounds.

Betaines

Quaternary ammonium compounds and betaines. Under neutral conditions betaines would be expected to resemble the non-ionics to a large extent, except that imposed on the curve would be their own moderate antibacterial activity. This is evidenced by the curve of activity remaining constantly high rather than a dropping off to a state of inactivation. The effects of such a mixture are shown in Fig. 8, in which a constant ratio of Q.A. compound to dodecylamine betaine was maintained in the case of both the Gram-positive and Gram-negative organism.

Phenols and betaines. Fig. 9 illustrates the effect of the combination of parachlormetacresol with dodecylamine betaine against *Staph. aureus* and *Ps. fluorescens*. The curves are those expected, *i.e.* increasing activity due to the reduction of interfacial tension, followed by a fall in activity. It must be noted that in this case the activity does not fall to zero, this being due to the intrinsic activity of the betaine itself.

Conclusion

The work described in the present article is primarily intended to give an indication of the potentialities of newer classes of surface-active agents, in the formulation of germicidal preparations. No doubt more members of these classes will become articles of commerce in the near future, and will circumvent many of the difficulties which were encountered as recently as 18 months ago when the first part of this article appeared.

We thank the directors of Glovers (Chemicals) Ltd. for permission to publish this article, and to Mr. F. James for assistance with many phases of this work.

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CORRESPONDENCE

Indigestion Powders—Misleading Advice

14th April, 1958.

To The Editor.

Sir: The Association for Consumer Research, who have now taken on the magnanimous job of watchdog for the British Public, would in our opinion be well advised to consult manufacturers of pharmaceutical products before publishing reports which utterly misrepresent some products.

We refer to *Which*, Winter issue Vol. 1, No. 2, in which in a report "Cures for Indigestion" the prices and values of various stomach powders are compared.

This evaluation is based misleadingly on cost per oz. When taking the powders, they are measured by volume, by the spoonful. Birley's is the lightest, hence, though its cost for a given weight is high, the cost for a given volume is much lower than many others on the market today. In fact, their 2s. tin has exactly the same cubic capacity as another brand (4th in their list) and rather more than double a 2s. 6d. brand (6th in their list). They have overlooked the fact that the first mentioned contains bicarbonate of soda which, being a much heavier powder, makes its *cost per weight* appear lower.

We feel sure you will agree that in important matters of this kind manufacturers should be consulted before statements, which can easily be very harmful, are published. Apart from harm to the sales of such an effective product as Birley's Antacid, the ultimate effect may be to mislead the very public they seek to advise.

L. C. Sage.
Geo. Murray (Advertising) Ltd.
London, W.C.2.

African Pyrethrum

Sir: The information about African Pyrethrum on p. 126 of your March issue is not wholly correct.

Our associated company, The East African Extract Corporation Ltd., Nairobi, for whom we are the overseas sales agents, will obtain under an agreement with the Kenya Pyrethrum Board a significant proportion of the Kenya crop of pyrethrum flowers.

These flowers will be processed by them and the bulk of the extract will be shipped to supply United Kingdom insecticide formulators.

J. G. Scott Marshall.
Mitchell Cotts & Co. Ltd.
London, E.C.2.

The news item stated that the Americans might bid for nearly all supplies of pyrethrum from Kenya. We are glad to publish this assurance that British insecticide formulators will continue to receive their requirements of pyrethrum.—Editor.

How **WORK STUDY** *Helps in the Design of Chemical Plants*

By E. H. Salisbury*

Work study—systematic analysis and ordered thinking based on a powerful questioning technique—can be of immeasurable value in the design of chemical plants, right from the research and pilot plant stage. Here the author discusses this important use of work study and considers other aspects of chemical plant design, such as the value of models in speeding up communication between the many people involved in planning and design.

I PROPOSE to consider the steps which ideally should be followed in the design of a chemical factory on a "green field" site. It is assumed that main services (road, rail, steam power, water, etc.) are available at the boundaries of the new factory—this assumption is made to simplify the problem and to permit concentration of discussion on the design of chemical plant.

It is assumed that the organisation responsible for the design of the proposed new factory is comprised of the following departments, which are to be primarily responsible for the specification, design, ordering and construction of the factory:

Research and Pilot Plant Department.
Process Development Department.
Engineering Department (Project, Mechanical, Civil, Structural, Electrical, and Instrument Design Sections associated with material supply, progress, planning and inspection).
Construction Department.

The research and pilot plant stage

It is assumed that the nature and amount of the final product from the proposed new factory are known, together with the basic process which will probably be employed.

The research stage involves the intensive study of the basic process and possible variations in it, helped by the application of the powerful work study techniques involving the critical questioning sequence.[1] Those who are to be responsible for the design and layout of the final plant should be closely associated with all work arising from the research and subsequent stages.

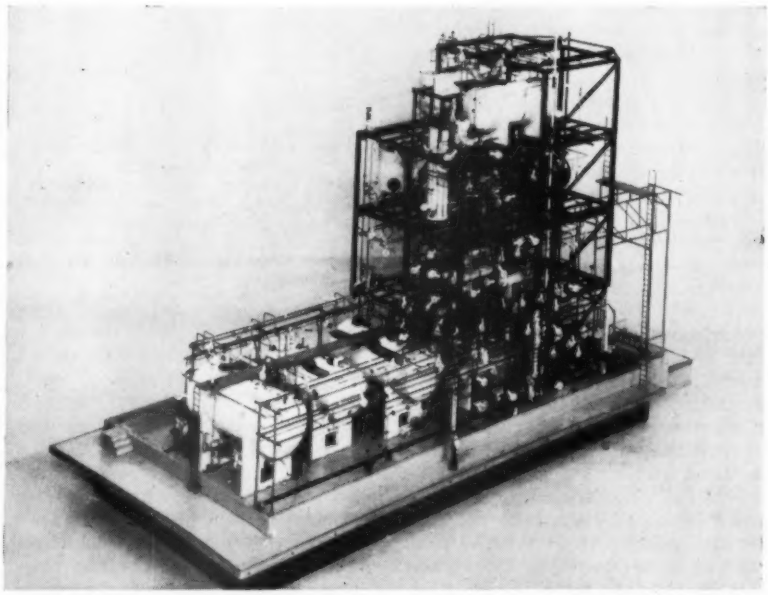
Alternatively processes may have to be examined in some detail with the object of ensuring that the final choice results in a minimum cost of product. Capital cost estimates made by the Engineering Department will also be necessary before a final decision can be made, based on the "economics" of two or more possible processes.

A process may be so novel, involving also special metallurgical and engineering problems, that it may be deemed wise to proceed with the building of a pilot plant before attempting to proceed with the final flowsheets.

The design of the plant should be considered in some detail by the Engineering and Research Departments to ensure that data sufficient for the solution of outstanding problems will be forthcoming. Metallurgical and other specialists should be consulted as occasion demands.

Failure to make provision for the solution of problems at this stage can result in serious delays when the final design stage is reached.

Again, the help of personnel



Courtesy Imperial Chemical Industries.

Models can be of great value to work study officers as well as to designers, medical, safety and fire officers. Models bring all these people together in fruitful discussion. The above model was made for an I.C.I. plant.

* A paper presented at a joint work study conference convened by the British Institute of Management in London, February 6. Mr. Salisbury is a member of the Chief Engineer's Dept., Billingham Division, Imperial Chemical Industries.

trained in the systematic approach and principles of work study will ensure that the maximum value will be extracted from pilot plant work.

It is highly desirable that all technical personnel engaged in this type of work—indeed in design work in all its phases—should be familiar with work study techniques.

Flowsheet stage

On conclusion of the research and pilot plant work the preparation of the final flowsheets for the new factory may proceed. These generally are prepared in outline giving the main process steps only, and the recommended equipment.

In this form the flowsheets reach the Engineering Department, whose responsibility is now to translate them into fully detailed engineering designs.

Some new projects may be very similar, or even "repeats" of plants already in operation, and the flowsheets would be based on these known processes. In such a case the critical questioning sequence based on flow process charts should be carried out before the final flowsheets are prepared. There must be very few processes which cannot be improved in the light of new knowledge and critical study. An examination of the costs of production and of maintenance of similar existing plants will often indicate those links in the production chain on which critical study should be concentrated, and which occasionally will yield spectacular results.

One major consideration at the flowsheet stage—and later in more detail during the final design stage—is that of maintenance. As process control becomes progressively more concentrated in the hands of fewer process operatives due to the growth of "automation," the ratio of maintenance labour to process labour will increase. There are many plants where the maintenance labour is many times that employed to operate the plant. The importance, therefore, of considering these problems early is vital, if one is to achieve the objective of producing a product at minimum cost.

The problems involved will generally be of a nature requiring close collaboration with Plant Work Study Officers.

An example of the type of problem which arises is the necessity to clean plant and associated pipelines at some regular frequency, in some cases measured in days. The layout of the plant involving facilities for rapid dismantling and cleaning is a problem most amenable to solution by work study methods.

Final design stage

The co-ordinating Project Engineer, on receipt of the flowsheets, is immediately faced with a number of urgent matters, all of which affect the completion date of the project.

Taking the example chosen of a chemical factory on a "green field" site, he must proceed with and co-ordinate the following activities.

1. The general layout of the factory.
2. The layout in detail of the constituent parts.
3. The preparation of detailed line diagrams.
4. The preparation of information required by the Service Sections (Mechanical, Civil, Structural, Electrical, Instruments, etc.).
5. The early ordering of material and equipment where current market conditions indicate long delivery—priority of design or of ordering of equipment is nearly always imperative.
6. Detailed design involving (in type of chemical factory assumed) piping design.
7. Planning, progress.
8. Cost control.

It is not proposed to deal with all these items in the paper but to concentrate on items 1, 2, 6 and 7.

The problem of communication

Before dealing with the stages of the final design process it is proposed to consider in general terms some of the problems relating to the "passing of information" between the many members of staff engaged in the design of a major project, and also those members of staff who, although not immediately associated with the design process, nevertheless contribute very valuable criticism and suggestions based on their experience in such spheres as plant operation, maintenance, work study, etc.

The previous section indicates the problems with which the Project Engineer is faced and much depends on how quickly information flows from the Project Station to the service design sections, and to other staff referred to above.

Methods of passing information and the speed of communication between all concerned can be a major factor in the building of a well-designed plant within the programmed time.

The question "How can we improve communication?" and the solution of similar problems can be answered only when there is full knowledge of present methods, and special effort may be necessary to obtain this latter information.

The whole subject is most amenable to method study and a description of one such study in a major design organisation may be of interest. With the full knowledge and co-operation of all concerned a study of present methods was instituted involving the technique of random observation.

The study involved activities under many headings such as "Drawing," "Drawing alterations," "Calculations," "Correspondence," "Obtaining and supplying of information," "Preparation of Technical data," and so on.

A random observation study may be defined as a series of instantaneous observations taken at random on the group or groups being surveyed. If sufficient observations are taken, that is, if the sample is large enough, the percentage of observations is a measure of the proportion of time during which a particular activity occurs.

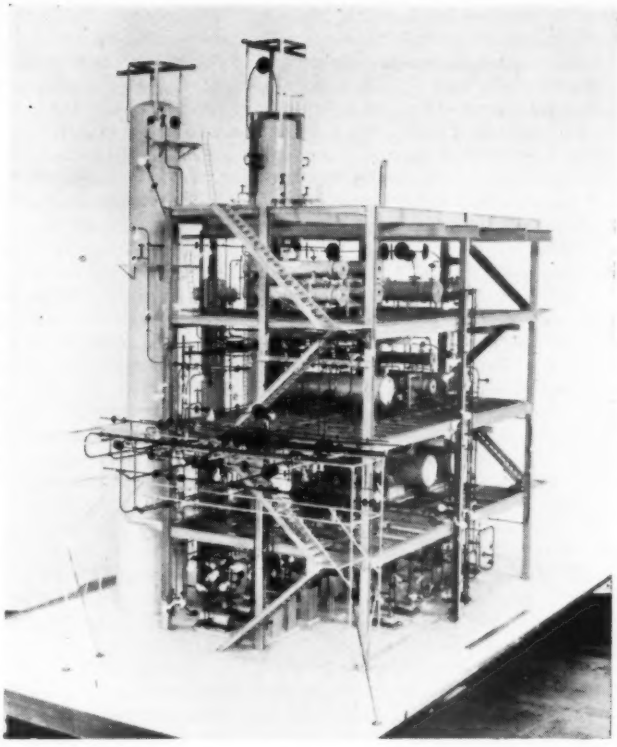
In the study referred to, the period of survey was not fixed at the commencement, but by examining the data as it became available it was found possible to stop the study after a period of twelve weeks. As a check it was decided to include in the list of activities "holidays" and "sickness," and the percentages of these two items as obtained in the random survey agreed very closely with the actual percentages.

The results of the survey were startling, indicating that a considerable percentage of available time was expended in "obtaining and supplying information." Improvement in methods arising from this survey is currently receiving much attention.

Importance of models

One major development arising from the above considerations is the rapidly increasing use of models.

The successful design of a new chemical factory or works depends not on the efforts of the Engineering Department alone, but on the joint contribution of a number of staff



Another I.C.I. chemical plant model, illustrating the remarkable detail which can be achieved. Models need not be costly.

Courtesy Imperial Chemical Industries.

not immediately associated with the design process.

In order that the ideas of these staff may be incorporated in the final design before it is too late, much depends on the speed of communication between the various interested members of staff in all the departments mentioned above.

The preparation of a number of scheme layout drawings of a whole factory and of its constituent parts may be in itself a lengthy process, as may also the circulation of these drawings with accompanying descriptive documents inviting comment.

Quite often there has not been sufficient time to incorporate important contributions from qualified staff because of delay in receiving comments and the need to proceed with the final design.

By adopting model techniques extremely valuable criticism may be stimulated from busy Plant Operating, Maintenance and Construction staff who generally find that they cannot afford the time to make a thorough study of a pile of drawings of alternative layouts. It is not uncommon to find a dozen or more highly qualified staff not immediately associated with the design process holding an enthusiastic group discussion round a model in company with the design staff. Their advice and help at this early stage is vital and a model enables this to be done with relatively little expenditure of their time, and with a corresponding saving of Design staff time. Work Study, Medical, Safety and Fire Officers find too that an appreciation of their special problems is enormously enhanced by resorting to model techniques.

The beneficial effect of rapid communication at all stages between all contributing departments and sections thereof is perhaps the greatest overall advantage flowing from the adoption of model techniques. The contribution and sifting of ideas at an early stage before design work commences, helped by experienced staff not immediately associated with the design process, can be most stimulating and sound suggestions can be incorporated before it is too late. All departments, therefore, are brought together early as a really effective team, with all the advantages that must flow from this.

The factory layout

The layout of the constituent parts of a chemical factory is a fascinating process. It is not essential to know accurately the overall dimensions of each constituent part, but some estimate must be made before the main layout can proceed.

Most designers will often resort to paper "cut-outs," each of which represents in plan the area of structure, building, workshop, office, etc.

Other designers prefer to use three-dimensional models to scale, which may be placed on a gridded base board and on which may be drawn roads, railways, pipe trenches, underground services, drains, etc.

Such three-dimensional models are extremely cheap to make, out of say cardboard tubing, tins, boxes, and other material normally regarded as scrap. With the aid of these simple constructions such features as the grouping of like sections together, the flow of services, the location of workshops, maintenance facilities, stores and plant offices, can quickly be established. All interested personnel would meet round the model and important comments would be noted on the spot.

Work study can play a most important part at this stage and probably two or more layouts would have to be examined in some detail before the final layout can be agreed.

The final agreed layout must, of course, be recorded, and this is essential information required by the Civil Engineering Section who will now proceed with the drawings of the main roads, rail spurs, drainage, etc. The Construction Manager is of course most anxious to see that the access road and rail connections and underground services are built as early as possible —good access to a construction site, with as few open trenches as possible, will earn the gratitude of the Construction Manager. He may also ask for priority to be given to say a store, maintenance building or workshop—these facilities if provided early can be a boon to the Construction department in that local storage and workshops capacity will inevitably speed the construction work.

Layout in detail

While the main factory layout is proceeding, the project design team is also busy developing layout in detail. An example of the type of work involved is a multi-storey structure housing a number of equipment pieces on each floor.

As in the case of the main factory layout, early comment from members of all interested departments is vital, and as a means of achieving this the "plant layout or preliminary" model built roughly to scale (say $\frac{3}{8}$ in. or $\frac{1}{2}$ in. to 1 ft.) is much preferred by the author and his colleagues to the time-consuming process of preparing scheme layout drawings of alternative layouts.

The "plant layout or preliminary" model should be made of components enabling the model to be quickly built and quickly altered. It should also be "flexible" in three dimensions—perhaps the most important requirement. This type of model is relatively very cheap and may take a number of forms, all having the object of "positioning in space" the equipment pieces.

At the "plant layout or preliminary model" stage, work study in more detail related to manning and maintenance problems is most conveniently carried out.[2] Such a study may result in changes in layout, but how much better it is to make alterations before final design work commences than after the plant is built! Anything which eliminates the need for modification after start up is to be favoured, particularly those which result in a reduction in the manning of the plant. Appreciable savings, too, in such related matters as "amenities" have followed from critical study at this stage, and it is not too late to implement the results of such study in the final design of amenity buildings.

Piping design

In some chemical plants of the type envisaged in this paper, pipe work, general arrangement and detail drawings may, in some intricate and complicated processes, absorb some 40 to 50% of the total "mechanical" design effort.

The author's experience of pipe work design for plants which generally are "non-repetitive" is that most draughtsmen find the work boring and it is certainly difficult to arouse enthusiasm for this type of work. It is also unreasonable to send a batch of pipe work drawings to busy plant people and ask for their comments. They will properly reply "That is one for the drawing office." The result is that, in practice, correction of faults occurs during the construction period and even after the plant is handed over, with consequent delay in production.

This subject has been discussed frequently during the past two or three years between representatives of the various Divisions of I.C.I. engaged in the design of chemical plants of the type under review, and a recent I.C.I. panel has unanimously recommended the adoption of the Piping Design Model. The Piping Design Model is receiving increasingly more attention both in the United States and in this country. The value and advantages of building a model to scale, including piping (generally 1 in. diameter and above), valves, instrument fittings, selected pipe joints, etc., are not obvious, and only by using them can their value be assessed.

It is not proposed to discuss the detailed methods employed in building the Piping Design Model beyond stating briefly that they make unnecessary the preparation of piping general arrangement drawings.[3] Fundamentally the pipe details are sketched from the model and experience shows how much more easily this is accomplished than when detailing from plan and elevation pipe general arrangement drawings.

Planning and progress

When the flowsheets have been received in the Engineering Department the preparation of project programmes should commence immediately. The great importance of good design planning and progressing is self-evident, and detailed attention to this aspect of project work will be amply repaid in that design work and construction work will proceed smoothly.

The Project Engineer in collaboration with the design and construction staff should prepare an overall programme resulting in a target completion date for the whole project.

Again the main problem in design planning is the passing of information to the service design sections and others in the shortest possible time, and in the correct sequence. This information may be expressed in the form of multiple activity charts showing for example when information should pass from the project section to the Structural and Civil design sections, bearing in mind that structural and plant erection cannot commence until the foundations are installed.

Many data are available from a study of previous projects of the type being considered in the paper, and although no accurate figures can be given the following serve as an approximate guide.

Taking the time interval between start of final design and completion of the project as 100%, design work should be sensibly complete by 75% of the time, and construction work should start when 25-30% of the time has elapsed. Any extension of the design time beyond the 75% mark does not allow adequate time for fabrication and erection of the last major items, and if construction work commences too early there is a danger of "overrunning" the supply of information emanating from the design sections.

It is stressed that the above percentages serve only as a rough guide, and they will vary with the type of project.

For a paper which deals with some of the above points see Ref. 4.

Dealing now with the ordering, progressing and inspection of material much depends again on collaboration between the Project Section, service design sections, and other service sections responsible for procurement of material. It is not proposed to consider these aspects in detail, but perhaps one or two suggestions may be made which may prove of considerable help to the Project Engineer who exercises overall control. These suggestions again arise from a study of methods of presenting information.

The Project Engineer should not be immersed in detail but should nevertheless be able to assess quickly the overall position relating to progress of design and procurement of material.

Visual aids are very helpful and are much preferred by many Project Engineers to written methods of presenting information.

The engineering line diagrams invariably show all the equipment pieces, piping and associated fittings. A simple colour code conveys information very quickly, *e.g.* a red line marked on the sketch of each equipment piece indicates that the final drawing has been completed; a blue line indicates that the order has been placed; and the amount of cross-hatching, the progress of fabrication. These coloured line diagrams should be located in the section which receives all progress

reports, etc., relating to material supply, and it is a simple matter to record the information in colour before filing the copy order or progress report concerned.

Another type of visual aid is that employed, for example, to indicate the progress of valves being supplied by a manufacturer. By plotting on a time basis cumulative orders for valves (irrespective of size or pressure standard) and corresponding cumulative deliveries it is easy to see whether rate of delivery satisfies the requirements of the programme. This system does not always provide information in detail, but it enables the Project Engineer to take action when it is seen that progress is not satisfactory. This system can be extended to steam traps, piping heat insulation and many other items.

The whole field of Progress and Planning is most amenable to Method Study and progressively more attention is being given to it.

A doubt expressed

Occasionally the question is asked "Does the application of work study principles add to the design time and time required to complete the project?"

There is nothing new in the basic ideas of work study. Before the advent of work study as it is known today, most designers gave consideration to such matters as location of service buildings relative to plant—what distances certain operators may have to traverse in the course of their plant duties, where should plant amenities be placed, etc.

Quite often these decisions would be based on a "hunch" and the result might well depend on the experience of the designer and of that of other colleagues he cared to consult.

What work study has brought to modern design problems is systematic analysis and ordered thinking based on the powerful questioning sequence technique. More and more information—especially concerning the manning (process and maintenance) of plants—is being made available to the designer, and helped by specialist colleagues there is very little danger of a major omission.

This systematic approach is overwhelmingly to be preferred to one where essentials have not been properly thought out. One can recall premature starts where, amid clouds of dust, noisy cries of "They're off," there has been a premature return to base because some major factor has been overlooked.

There must of course be a time limit in the project programme when critical examination must be complete, but all staff responsible for design in the Divisions of I.C.I. with whom the author has consulted are convinced that careful and systematic thought expended at the beginning of a major project will result in a shortening of the design time and in the project being brought into production very much earlier than would otherwise be the case, and with much less fuss and later recrimination.

There surely is no alternative to orderly thinking and the systematic approach, if one is to achieve the best results in any phase of industrial life—or indeed in any other sphere.

ACKNOWLEDGMENTS

The author records his thanks to his colleagues, too numerous to mention, in many Divisions of I.C.I. and in Head Office, with whom he has had the opportunity of discussing design problems and who have contributed so much to the techniques now being employed within I.C.I.

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Uses of Gas-liquid Chromatography

The cosmetic industry was the first to acclaim the new method of analysis known as gas-liquid chromatography. Because of its importance to the industry the American Society of Cosmetic Chemists made the annual special award for 1957 jointly to Dr. A. J. P. Martin, F.R.S., and Dr. A. T. James, who together developed the process. The British Society was honoured by the presence of Dr. James at the first scientific meeting of the session at the Royal Society of Arts. The President, Mr. J. Pickthall, took the chair when Dr. James gave a fascinating account of the method and suggested a number of uses to which it might be put in the cosmetic industry.

After tracing the relationship between gas-liquid chromatography and the process of distillation, Dr. James described the special conditions applying to the new method. The substances amenable to treatment must be distillable other than by molecular distillation and have a vapour pressure of not less than a few mm. of mercury at the temperature of the column, say between 150° and 200°C. The stationary liquid phase must have a low vapour pressure, in the order of 10^{-3} mm. Hg, at that temperature. By using at one time a stationary phase of a saturated compound such as paraffin wax in which only Van der Waal's forces can operate, and at another an aromatic compound containing centres of unsaturation, very much more information can be obtained than by any process of distillation. In any investigation by the method it is desirable to change the nature of the stationary phase in this way. The liquid phase is preferably mounted on about 2·5 g. to 10 g. of kieselguhr, and the powder so impregnated must be very uniformly packed by vibration into the narrow tube of the column.

The various methods and types of equipment required for the detection and estimation of vapour emerging from the column were illustrated by lantern slides. Among the striking examples of application an account was given of the determination of the position of the double bond in an unsaturated fatty acid by gas chromatography of the oxidation breakdown components, a mono and a dibasic acid. The recognition of fatty acids containing an uneven number of carbon atoms in the molecule in natural products such as rabbit sebum was described.

Packaging ⋆ Handling ⋆ Transport

THE FREE MARKET CHALLENGE TO THE CHEMICAL INDUSTRY

At the packaging conference organised recently by the Association of British Chemical Manufacturers speakers discussed the probable impact of the European Free Market upon the packaging, handling and transport of chemicals. Will the carboy survive? What of bulk transport? How much could be saved by better handling? These are examples of the practical questions posed and answered in the following report of the conference.

Packaging and Distribution

By R. E. Rushen (*Imperial Chemical Industries Ltd.*)

THE PLANT manager wants to ensure that the chemical he is making will reach the consumer in perfect condition. He wants a container which, particularly if it is a metal container, is of the right size and weight and which, whether empty or filled, can be handled and stored easily. He likes his containers to fit into a tidy pattern and this calls for simplicity of shape.

Strength. The shipowner looks for a strong package so that whatever mishaps may occur in handling the goods or in stowing them the chemical will stay inside its container and will introduce no elements of hazard into his task. He prefers packages which are easily stacked and which can, if possible, play a useful part in themselves in trimming his total cargo.

However, any improvements which are to be made in the preparation and presentation of packages should not, in any way, threaten to undermine the safety factor. On the other hand, the conferment of strength should not make it impossible to open containers without running the risk of contaminating the contents by bits of solder or even small chips of steel. Steps should be taken to ensure that any knack which is required, or special instructions, or tools, are at the services of the customer, particularly the overseas customer.

Marking. The overseas customer also attaches great importance to marking, particularly product marking. Marking on the end of a drum is quite satisfactory if the drums rest on their sides. Our overseas customer, however, may stack his drums on end, in which case the marks will be invisible. The only safe rule to follow is "too many marks rather than too few." Also, remember to translate pounds into kilos in marking the container.

Bag packaging is the accepted method of transporting many chemicals. British bag packings enjoy a high reputation, and in spite of the temptations which they offer to the stevedores to use hooks, on the whole their condition on arrival is good.

There is still room for improvement in the marking of bags, particularly hessian bags. I have seen in overseas warehouses a good many bags containing British chemicals upon which the marking was completely obliterated.

The increasing tendency towards multi-ply bags, usually with some form of waterproof lining, overcomes the marking problems and can often be the best answer, provided that the bag is strong enough for the job it has to do, allowing for the handling it undergoes en route.

Bulk transport. With the advent of the European Free Trade Area bulk transport will become more important to our export trade. A number of British companies, including my own, are already supplying chemicals in road, rail and even sea tankers to European customers. British Railways need to take note of these new tendencies in export transportation and to start reconsidering their costing of rail tank carriage. Rail and ferry rates must be adjusted to enable us to compete on reasonable terms with our continental competitors.

Bulk transport for export by road, both of solids and of liquids, even without the much discussed Channel Tunnel, will also grow in the next few years. We are always bound to be at some disadvantage on the Continent in view of the normally greater distance involved and because of the necessity of cross-channel ferry. But this should not discourage us from exploring every aspect of this problem.

No better prestige advertising could be devised than the sight of British railway wagons and British road tankers constantly passing along the railways and roads of the continent of Europe. Of course every attempt must be made to ensure that such vehicles are a credit to the British chemical industry. No goodwill is going to be achieved by using dirty or out-of-date equipment.

Packaging and Handling

By Geo. Downie (*Materials Handling Dept., Transport Division, Unilever*)

EACH YEAR the chemical industry spends about £13·6 million on handling alone. A deliberate effort to reduce this figure by even 10% could result in a saving of £1·4 million per year, a substantial sum for any industry to save on any one aspect of its business.

Handling costs involved during Customs inspection and other transfer stages can be as much as 33% of the cost of manufacture, vital constituents in the cost which we have to charge to our overseas customer.

While we sell "f.o.b. U.K. port" our European competitors sell "delivered to destination," implying that they take a greater interest in the safe arrival of their goods. They have taken advantage of modern handling aids, replacing the heavy wooden case with a light fibreboard case which they have elected to place on a pallet and offer this for transport to overseas customers. It is questionable as to what extent the average British exporter demands this modern service from his carrier in his customer's interest.

Pallets. In the likelihood of the setting up of an international pallet pool British exporters may well have a vital interest. Containers suitable for international exchange are becoming increasingly available. Container ships are being built for the North Irish channel, where over 26,000 containers are carried each year. Is there

an opportunity here for a similar development across the English Channel?

Port handling facilities could probably be improved by closer co-operation between user, carrier and port authorities.

By using pallets and other mechanical handling devices such as lift gear and conveyor belts more rapid loading is being achieved, enabling cargo ships to be turned round more quickly in many ports in Britain, the United States and Scandinavia.

The choice of a palletised handling system is influenced by many factors, including (*a*) the recognition of the advantages of a brick-shaped package or sack, and (*b*) the skill of the salesman in selling in unit or pallet loads with its attendant economic advantages. These developments call for a more ready acceptance by shipping conferences and other carriers of unconventional or unusual packages at companies' risk.

Bags. Another interesting development is the use of jute and polythene bags and paper-lined jute bags for powders. Here it is thought that suitable bag-formers could, without damaging the contents, form or shape the filled bags so that they can be readily palletised. There is also the stressed skin type of package using "sisalkraft" or similar wrapping, which has value for re-use in some overseas markets.

Bulk handling of powdered solids include systems such as fluidisation, direct pressure or vacuum. Savings in money and transit time are the biggest advantages of some of these systems.

Ships equipped with stainless steel tanks for orange juice, capacity 650,000 gal., travelling from Florida to Long Island have, it is estimated, saved £90,000 per shipment over alternative forms of transport, such as refrigerated road vehicles.

Canadian National Railways and Lever Bros. Ltd. have designed aluminium containers set in steel cradles, capacity 12,000 lb., used to ship liquid between Toronto and Newfoundland. Savings in time and a fresher product is achieved than when previously shipped in drums.

For near continental destinations demountable containers are valuable for handling as well as for individual packings such as drums, fibreboard kegs, etc., on pallets. Where two-way traffic is envisaged the demountable pressure vessel should be considered.

Parachute delivery. Cargo handling by air is not new, and the possibility has not yet been fully explored of parachuting supplies of suitable materials. Already equipment exists for the rapid clearance of dropping zones. For example, fork-lift trucks with a useful cross-country performance are available to pick up pre-packed bales or hampers or pallet loads which have been landed by parachute.

Technical Packaging Problems

By G. L. Riddell (*Packaging Research Division, Reed Paper Group*)

IN PACKAGING chemicals for the European Free Trade Area one must think of the market and the climate to which the package is going and the transport system by which it will travel. The temperate zone of the E.F.T.A. presents no difficulties for most chemicals and the transport system has now been used for so long that we know what most of the problems are.

The bulk shipment of chemicals to European customers' works by road and rail has been mentioned. Thought should also be given to the question, "Where shall one pack if smaller than tank lots are required?"; at the factory or at a continental repackaging depot? The answer may affect the kind of package you will find most convenient and cheapest. For example, if a liquid chemical is being shipped to Italy, a glass carboy might be out of the question if the packaging were done in the U.K., whereas if it were sent in bulk to Italy and there put into returnable carboys they might be economical and convenient.

Carboys. The glass carboy has served the "wet" chemical trade well. It is a first-class container but it is essentially a returnable one, and when used for export there are high freight charges in both directions. A stronger, light-weight, straight-sided or rectangular carboy is needed.

The most likely package to replace the glass carboy may be reinforced plastic containers, such as the metal clad polythene drum or the plastic "bag" inside a fibreboard case or drum.

Drums. Light-weight, low-cost returnable metal drums will be increasingly used when they become stronger and cheaper with more secure and more easily opened closures. Square drums would reduce freight costs and save stacking.

Attention will have to be given to the production of rust-free steel drums. Alternatives are plastic liners, aluminium or tinplate drums which do not rust so readily, or the use of protective lacquers.

In the event of bulk shipping to the Continent the package as well as the product may be shipped to the packing centre. There are several advantages in having packages which will travel, and here the drum manufacturer may copy the can manufacturer and squash the drum bodies flat before shipping and erect them at the packing point by reconverting the bodies to a cylindrical shape and putting on the ends.

Non-metallic drums are likely to be increasingly used. I understand that phosphoric acid is being shipped in fibreboard drums in the U.S.A. The plywood drum, which is generally more expensive than metal in this country, is used on the Continent for liquids and powders.

Sacks. The jute sack has many desirable properties over the paper sack, but they can only fully operate when there is a neat and tidy circuit for their return and re-use, or where, because of special local reasons, they have a high second-hand value. At one time an advantage of the jute sack was its ability to carry heavy loads, but people now have little enthusiasm for lifting heavy loads by hand, and if mechanical aids are necessary use will be made of the intermediate bulk containers holding between 1,000 lb. and 3,000 lb.

The construction of the multiwall paper sack has to be improved to resist the penetration of water, water vapour and other gases.

Plastic sacks of polythene, p.v.c. and Melinex are being used experimentally for chemicals. Sack problems include the development of satisfactory methods of opening and re-sealing.

Cases. The wooden case, while being heavy, bulky and costly, has two advantages over its fibreboard competitor: it retains its strength when wet and can carry heavier loads. In making good these deficiencies in the fibreboard case a technical solution at low cost still has to be found.

Improvements in internal fittings in cases would give greater protection to the contents against mechanical damage.

All these packages are likely to face competition from bulk delivery. So far as the E.F.T.A. is concerned I am sure Mr. Rushen is correct when he says that this method of delivery will increase both by road and rail.

I.B.C. A relatively new field of packaging is the intermediate bulk container, which is a large-sized package containing 1,000-3,000 lb. Mechanical aids to handle such weight could be simple—a joist and a dolly will do in many cases.

These containers may be of various kinds; for pastes and viscous liquids it may be a plastic collapsible tube which is emptied by rolling up and returned in this state for refilling. Another kind of I.B.C. is a large paper sack which is contained in a collapsible wire mesh crate for additional strength. The paper sack is expendable and the wire mesh crate is collapsed and returned. Another device is the large tank (100 gal. upwards) which is delivered and collected when empty. They have created interest in the United States and are now being considered in this country for the delivery of both "wet" and "dry" chemicals.

COSMETICS and Toilet Preparations

Allantoin • Infra-red spectroscopy • Squeeze-bottle dispensers
Analysis of alkyl benzene sulphonates • Surface-active agents
Effect of soaps and detergents on skin

By W. W. Myddleton, D.SC.

Allantoin in creams

Allantoin has been incorporated in some cosmetic preparations such as hand lotions and after-shave creams for a few years, although the recognition of its cell-proliferant and healing action belongs, with the discovery of allantoin itself, to the nineteenth century. The creators of toilet and cosmetic novelties and products with a story appear to have missed a scoop in the case of allantoin.

This substance takes its name from the allantois, a structure which plays an important part in the protection and nurture of the embryo in the land animals. It is therefore associated with the higher stages of evolution through which these embryos pass in their pre-natal development. Allantoin was discovered in the allantoic fluid of cows and has since been recognised in other mammals, including man. More convenient sources have become available; for example, it occurs in the root of the comfrey (*Symphytum officinale*) and is present in the infusion of the root, highly valued for its healing properties.

In a critical survey of the literature dealing with the cell-proliferant and therapeutic action of allantoin Dr. A. M. Posner[1] cites evidence of the successful treatment of refractory ulcers and suppurative wounds with synthetic allantoin, but warns that adequate tests and controls have not been carried out. Evidence of cell proliferant action is derived from the observed healing of wounds and is therefore necessarily qualitative. Tissue culture has not been successfully exploited even qualitatively. Allantoin does not play an important part in normal human metabolism and occurs in small amounts in normal human urine. The present writer suggests that the presence of allantoin in larger amounts in the allantoic fluid is due to its presence in the urine of the embryo discharging into the allantoic fluid.

Reports from other observers are quoted claiming that the oral administration of allantoin could account for an increase in the leucocyte count of the blood by from 5 to 15%. (The leucocytes are bacteria-destroying white blood corpuscles, normally present in human blood to the number of seven to ten thousand per cubic millimetre.)

Optically active forms of allantoin

A vitally important point emphasised by Dr. Posner is that allantoin can exist in a lævo- and a dextro-rotatory form, the natural product probably being dextro-rotatory. It is readily racemised by heating a solution, especially at a *p*H over 7. The infusion made from comfrey root is therefore racemic. The racemic form may show the full therapeutic activity of the d-component, but it would not be altogether surprising if the l-component, instead of being therapeutically inactive, actually exerted an inhibiting or even a toxic effect.

The conclusion reached is that allantoin must be more fully investigated before it can be assessed as a valuable cosmetic material. It has been omitted from the latest British Pharmacopœia.

I-R spectroscopy in the analysis of creams

In a discussion some years ago[2] on the uses of infra-red spectroscopy in the analysis of cosmetics it was pointed out that the main difficulties were the formidable task of building up a reference panel of the spectrographs of the main components used in the manufacture of cosmetic products, and secondly the fact that water exerted a disturbing influence, thus making it difficult to examine emulsions by this method. In view of the short time required for the completion of a spectrogram, 10-15 min., the method was considered worthy of exploration. The paper includes the infra-red spectra of a number of cosmetic materials.

Details have now been given of the application of infra-red spectroscopy to the analysis of emulsion polishes.[3] The general principles of the method will undoubtedly apply to cosmetic creams.

The same requirement is postulated here of a reference panel of the spectra of the component materials of such emulsion creams, and again a number of these are reproduced in the paper. The emulsion is examined directly by depositing a film on a silver chloride disc and evaporating off the water. Further observations are made on various extracts made from the emulsion—for example, the benzene insoluble fraction, the benzene soluble-heptane insoluble fraction and the benzene soluble-heptane soluble fraction. An example is given in detail.

Polyethylene squeeze bottles

In a report to the Chemical Marketing and Economics Division of the American Chemical Society in September 1957[4] it was stated that cosmetics manufacturers account for 50% of the polyethylene squeeze-bottle market in the United States.

There are many advantages in this form of dispensing for cosmetic products which account for its popularity in spite of the higher cost. At the same time it must not be assumed that no formidable difficulties still stand in the way of greater expansion or indeed of continued use on the present scale.

The special characteristics of a squeeze-bottle are that it is versatile, dispensing powders in a fine jet, creams as ribbon or cord, and liquids as discrete drops, jets or sprays. One may add to this that a narrow-necked bottle is cleaner in use than a wide-mouthed jar from which the cap is frequently removed and which may be contaminated from time to time by the insertion of a finger to reach the cream.

The special characteristics of polyethylene commend it for the construction of the squeeze-bottle. It provides for a variety of colouring either to match the product or the companion packages, and at the same time the colour may be used to aid recognition of the brand of the product. The polyethylene bottle is light and durable, withstanding impact and shock, of good flexibility and "snap-back" recovery.

The paper, as summarised in the citation, also discusses the problems arising in the case of cosmetic products. Visible defects may appear in the bottle itself as well as serious defects in the contents. Deformation of the bottle has been observed after a period of storage and this is generally ascribable to the presence of mineral oil in the product, particularly in water-in-oil emulsions. Oil-in-water emulsions are not so likely to cause this trouble. As an intermediate stage the w/o emulsion may cause the bottle to feel unpleasantly greasy and even to smear from the bottle on to clothing.

Under other conditions the bottle may acquire a film of closely adhering dirt by electrostatic attraction. Attempts are being made to overcome this by incorporating an antistatic agent in the polyethylene.

The permeability of the bottle which gives rise to greasiness or deformation also causes such deterioration in the product as rancidity, change in colour and in perfume characteristics, as well as loss in weight of contents. One may add to this that the product may take up odours from the surrounding atmosphere when strongly-smelling articles are stored nearby or when the atmosphere is foul.

As a means of reducing permeability the paper suggests either the lining of the bottle with less permeable films of polyvinyl alcohol or polyvinylidene chloride, a procedure which has met with some success, or alternatively the use of a higher polyethylene polymer in the construction of the bottle. The use of a polymer of specific gravity between 0·93 and 0·94 may be satisfactory for borderline cases where the effects of permeability are not very serious with the ordinary type of polymer. Increase in gravity above these limits does not contribute to any further significant improvement and moreover flexibility and "snap-back" recovery of the bottle are reduced as the specific gravity is increased.

The statement that polyethylene provides an effective barrier to water vapour requires some modification in the light of an earlier publication[5] showing that the internal pressure in a polyethylene bottle with a wall 0·05 in. thick increased in four days by 10 mm. mercury when stored at 60°C. The mechanism producing the increased gas pressure within was considered to be a difference in partial pressure of water vapour inside and in the surrounding atmosphere. The conditions suggested to minimise the rise in pressure were a cool damp storage atmosphere free from draughts. In climates with a high temperature, especially when relative humidity is very low, extra care must be taken, but in the case of bottles with a reasonably thick wall a good quality carton may afford the necessary protection.

Analysis of alkyl benzene sulphonates

Some valuable summaries of published work have recently appeared dealing with a number of different subjects of interest to the cosmetic chemist. Methods which have been described for the analysis of alkyl benzene sulphonates have been reviewed critically as applied to the analysis of detergents based upon dodecyl- and pentadecyl benzene.[6]

The well-known method of titration with a standardised solution of a cationic compound such as cetyl trimethyl ammonium bromide in the presence of chloroform or carbon tetrachloride presents a problem in the standardisation of the quaternary compound. The Task Group No. 15 of the A.S.T.M. Committee D-12 has expressed the tentative opinion that although the usual standardisation with potassium dichromate is stoichiometric, the cationic reagent so standardised does not react in a stoichiometric manner with the sulphonate.

For maximum accuracy the alkyl benzene sulphonate should first of all be prepared in a pure condition and this sample used to standardise the cationic agent. When it is a matter of examining a single sample the procedure can be modified without this titration by a succession of determinations summarised thus:

$$\%\ \text{sodium alkyl benzene sulphonate} = 100 - (\text{alcohol insoluble } \% + \text{water } \% + \text{neutral oil } \%).$$

When it is desired to plan a series of analyses on different samples, the molecular weight of the alcohol-soluble material should be determined and used in conjunction with the volumetric method. The molecular weight does not vary significantly from batch to batch in manufacture. The molecular weight is determined by extracting a weighed sample with hot alcohol evaporating to dryness and dissolving in water. After acidification with hydrochloric acid benzidine hydrochloride is added and the precipitate rinsed with water, dried and washed with normal pentane. A weighed sample of the dried complex is dissolved in alcohol and titrated to *p*H 8·5 with decinormal sodium hydroxide. A blank containing alcohol only is also titrated to *p*H 8·5. The molecular weight of the sodium salt is given by the following equation:—

$$\text{Mol. Weight} = \frac{\text{Weight of benzidine complex} \times 1{,}000}{(\text{ml. NaOH for sample} - \text{ml. NaOH blank}) \times N - 70}$$

The paper gives details of methods for carrying out the different estimations involved in these procedures with details of reagents and satisfactory equipment. The calculations are described with valuable annotations and assessments of precision. Methods of sampling are also discussed. Although the author states that the methods described are not claimed to be original, the treatment of the subject is most helpful to the analyst.

Revised list of surface-active agents

The bewildering increase in the number of surfactants on the market is made even more bewildering by the variety of trade names given to them by their manufacturers and by the use of trade names by authors describing formulations and the results of investigations into their use.

In some cases it appears that the properties of a surfactant may depend upon the method employed in synthesis, and so the supposedly identical substances appearing under two different trade names may be significantly different in behaviour.

Added to this complexity is the fact that different countries apply different trade names, again without disclosing the method of synthesis. Nevertheless it is useful to have a list of whatever surface-active agents may be available.

Part II of a Fourth Revision of American Synthetic Detergents and Emulsifiers[7] has appeared extending from Betramine-, a sulphated alkylol amide, to Intramine-Y, the sodium salt of sulphated lauryl and myristyl colamide. The table is in the familiar pattern, giving such condensed information as Manufacturer, Class and Formula, Main Uses, Form, Concentration of Active Agent, Type and Miscellaneous Remarks.

Effect of soaps and detergents on human skin

Two excellent summaries of the literature dealing with this subject have been published. In the first of these[8] the results of important investigations on such matters as the adaptability of the skin to detergents, the defatting effect and its consequences and the function of the barrier layer of the skin are reviewed and discussed. Attempts to compare the effects of soaps and synthetic detergents on the skin are complicated by the presence in some synthetic detergents of added alkalis, by temperature, concentration and differences in duration of contact and also in respect of the general health of the skin.

The case is cited of the dish-washing detergent based on sulphated coconut monoglyceride which was introduced in the hard-water areas of the United States without causing complaints. The same type of detergent was introduced in Switzerland in 1948. Here, as a result of general complaint, the detergent was withdrawn and replaced by one based on an alkyl aryl sulphonate. In 1954 the housewives who had lodged complaints of the sulphated coconut monoglyceride were asked to revert to its use for a period of three weeks. This time there was only one complaint, and from this circumstance it is suggested that the skin becomes adjusted to contact with synthetic detergents after the shock of the first exposure.

The old view that synthetic detergents cause a feeling of harshness because of their defatting action on the skin is held to be inadequate, because the regeneration of fat on the defatted skin occurs in a matter of 1 or 1½ hr. and the feeling of harshness may last much longer. The work of Schneider[9] is quoted as showing that the oil secreted by the sebaceous glands is hydrophilic in character because of the presence in it of cholesterol and other emulsifiers. The hydrophilic sebum therefore aids in keeping the skin soft by holding moisture in the epidermis.

In the opinion of Professor Szakall the *stratum lucidum* which acts as a protective barrier layer for the skin has a high water content and also contains significant amounts of water-soluble substances. The loss of extractives from this layer is held to be the cause of the feeling of harshness after prolonged contact of the skin with detergents. The synthetic detergents can penetrate more easily than soaps to the barrier layer to effect this damage because of the smaller size of the micelles.

Methods of investigation. The second survey[10] deals with the methods and apparatus used in carrying out the different types of investigation on the effects of soaps and synthetic detergents on the living skin. In each case an assessment is given of the reliability and value of the procedure.

Skin cleansing properties have been investigated by top-light microscopy or micro-photography. As an alternative method an artificial soil containing a fluorescent mineral oil has been used for the examination of the original, the residual soil being determined by a reflection photometric method to provide numerical values of cleansing effect. Mechanical washing procedures have been introduced to make the test independent of the personal factor in the washing operation. It is pointed out that the results depend upon the surface condition of the skin as well as the experimental method of soiling.

Effect on the skin. Subjective clinical observation is the usual test method, but attempts have been made to obtain numerical values by the adoption of a scoring system. Microscopic examination has been carried out with vertical illumination by means of a ring condenser enclosing the objective. By this means it is possible to exclude shadows and avoid distorted pictures.

Dermatograms have been employed to obtain a print of the skin surface on high-gloss paper after applying an even film of printer's ink to the skin. Qualitative and quantitative determinations have been made by the "light-cut" method borrowed from metallurgy.

Redness and swelling of the skin through congestion of the blood vessels have been assayed by light-reflection methods, but the results are unsatisfactory because of the many factors influencing reflection. Other modifications are found to depend upon the individual under test.

Buffer capacity of the skin. The effect of detergents upon the natural protective acid mantle of the skin has been investigated by using colour indicators and also electrodes of various kinds. The time required for the regeneration of the acid mantle indicates the intensity of the effect of the detergent. The author points out a number of complications in this procedure. For example, rinsing with ordinary water can disturb the *p*H value of the skin; after using a detergent it is important to remove all detergent from the surface. It is therefore necessary to take other tests into consideration before arriving at any conclusion.

Alkali neutralisation capacity. Measurements of skin *p*H do not take into consideration another defence mechanism of the skin, the alkali neutralisation capacity. Studies have therefore been made of the time factor in the neutralisation of a dilute solution of caustic soda in contact with the skin, using a *p*H meter.

The story is advanced a stage further by observing also the time factor in the neutralisation of dilute sulphuric acid in contact with the skin.

Water content. Factors influencing the previously-mentioned measurements are water content, water holding and absorbing capacity of the *stratum corneum* of the epidermis.

The measurement of water content by the employment of the resistance offered to a direct current between two needle elec-

trodes is considered to be unreliable, mainly on account of polarisation.

The author describes a direct method in which the horny layer is scraped off untreated and differently-treated areas with a sharp scalpel. The moisture content of the scrapings is determined gravimetrically. The results have not yet been published.

Wettability. Measurements of wettability have been made by observing the angle of contact or the spreading of a drop of water on the skin surface.

Sebum level. This has been measured by direct extraction with a solvent such as petroleum ether over a fixed surface. Quantitative results have been obtained by evaporating the solvent and weighing.

The chemical characteristics of the sebum such as iodine value, acid and saponification value and also the cholesterol content have been determined. In this way the defatting effect of soaps and detergents can be investigated and the time required for regeneration of the sebum by the skin determined. There is general agreement that the restoration takes place under normal conditions within 90 min. of treatment with the detergent.

Chemical changes in the skin have been followed by determining the increase in the sulphydryl groups after treatment with the detergent.

Patch tests. Many modifications have been introduced in the patch test to meet serious criticisms of unreliability. There are so many variable factors that the patch test may easily give rise to mistaken conclusions. In the most carefully chosen conditions great circumspection must be observed in the interpretation.

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DISINFECTANTS and Disinfection

Carbon dioxide • Metallic ions and EDTA • Pemphigus control • Viability of E. coli

By A. H. Walters, F.I.M.L.T., M.R.S.H., M.I.BIOL.

Inhibiting effect of CO_2

FOR nearly half a century CO_2 has been used to stimulate when necessary growth on artificial culture media. This use of CO_2 appears to have been rediscovered by bacteriologists at various intervals. Many workers have indicated that the growth of "delicate" organisms could be enhanced by the inclusion of 5-15% of CO_2 in the atmosphere of the culture. Latterly, however, one worker has reported that while increased CO_2 appeared generally to accelerate growth of certain strains of tubercle bacilli on oleic acid-albumin agar, two stock strains were inhibited or showed diminished growth. From each of these strains two variants were grown, one being stimulated and the other being retarded or inhibited by incubation in an atmosphere containing 5-10% CO_2. For identification the two variants were named "CO_2 stimulated" and "CO_2 inhibited." For cultivation under such conditions desiccators were used.[1]

It was discovered that growth of the CO_2 inhibited variant was not depressed by CO_2 if the oleic acid albumin complex in the medium was replaced by simple bovine albumin. This observation set in train a series of experiments to ascertain in what respect the depression phenomenon depended on the composition of the culture medium. For instance, the addition of 1 mg. per ml. vitamin B_{12} to the medium completely abolished the depressing effect of CO_2 on sensitive variants and produced enhanced growth. *p*-Aminobenzoic acid, calcium pantothenate thiamine hydrochloride, cocarboxylase, pyridoxine hydrochloride, pyridoxamine dihydrochloride, folic acid, thymidine, deoxyadenosine and uracil had no effect under these conditions. On one strain inclusion of L and D methionine and D-alanine 2 0·5 mg. per 1 ml., in the medium abolished the CO_2 depressant effect.

The author noted that oleic acid albumin medium imposes on certain T.B. strains a requirement for Biotin, and that increased CO_2 tension reduces this requirement. The CO_2 inhibited variants studied were not, however, stimulated by biotin. It was then assumed that the CO_2 inhibiting effect was due to combination of the gas with endogenous biotin. By adding 4 (Imidazolidone-2) caproic acid to the medium to neutralise endogenous biotin the inhibited strain then grew well in a CO_2 atmosphere. Normally biotin is regarded as a growth factor, but in this case the use of a biotin neutraliser actually stimulated the growth of a variant which would normally be inhibited by increased CO_2 tension.

This excellent piece of academic research once again focuses attention on the great importance of the fullest possible understanding of bacterial metabolism which always must influence any type of growth-no growth studies. Those interested would need to read the original paper. Applied workers must always remain in the debt of academic workers in this field.

Metallic ions, EDTA and streptococcal infection

Some interesting work has been done *in vivo* on metallic ions, EDTA and a streptococcal infection.[2] Small doses of cobalt nitrate were injected into mice infected intraperitoneally with viable streptococci. Compared with control infected mice those injected with cobalt or EDTA died very much sooner. Further tests showed, however, that if the streptococci were grown first in broth plus cobalt or EDTA broth and subsequently injected into mice there was no shortened death time. Leu-

cocyte response experiments showed that when infected mice were injected with cobalt the normal rises in polymorphonuclears and mononuclears did not occur. Hence it was concluded that cobalt has an effect on the host which resulted in apparent (but not real) increased virulence of the streptococci. The mononuclears seemed most affected, with the result that streptococci multiplied freely in the peritoneal cavity from whence they were "showered" continually into the general circulation. Thus the injection of cobalt was considered to have an effect similar to the injection of a larger infective dose of streptococci.

Similar experiments using $FeSO_4$, $CuSO_4$, $ZnSO_4$, $MnCl_2$, $MgSO_4$ and $CaCl_2$ did not lower host resistance.

The doses of EDTA or cobalt nitrate employed produced no deaths either alone or combined when injected into 12 groups of mice. When EDTA or cobalt was included in broth, cultures of streptococci grew normally and produced no morphological or colony changes. The effect of EDTA on leucocyte response does not appear to have been observed in this series of experiments.

Although this paper is concerned mainly with alteration of resistance to streptococcal infections, since EDTA is today being included in various compounds concerned with disinfection, this aspect of its function is worthy of study.

Control of pemphigus

Some observations have been made on a small outbreak of pemphigus neonatorum caused by *Staph. aureus* type 71. Repeated swabs were taken of noses of 227 babies until they yielded *Staph. aureus*. By the fourth day 67% were positive. Positive cultures were also obtained from normal skin on the back of the neck, the umbilicus and the groin. Swabs of the noses and hands were taken of nurses, and 85 mothers had nasal swabs. Investigations were also made of babies' bedclothes and garments. From all sources 874 coagulase - positive staphylococci were isolated, 551 being penicillin-resistant. Thirteen pemphigus pustules and 17 cases of sticky eye coagulase positive staphylococci were also obtained.[3]

Staphylococcus type 71 was new to the hospital. It was isolated from the nose and hands of a nurse, from various pemphigus lesions, the air, clothes and bedclothes, and from a baby's normal skin. The outbreak was controlled by isolation and barrier nursing, intramuscular streptomycin and local antiseptics, isolating contacts, and autoclaving all relevant garments and bedding. Latterly all babies' garments and blankets were disinfected with cetyl trimethylammonium bromide. Continued tests after the epidemic subsided failed to reveal the epidemic strain of staphylococcus, but investigations are still proceeding. The authors incline to favour Graneodin ointment for the treatment of nasal carriers.

This paper is unique because the authors suggest "that the first case of pemphigus resulted from direct infection by Nurse C, possibly via her hands." Subsequent cases arose from cross-infection. The demonstration of the possibility of potential pathogens in the resident skin flora of hands was shown by Walters.[4] To recover such organisms finger pad press plates of damp washed hands is quick and easy, and perhaps more effective as a first investigation possibly than nasal swabs. This paper is of very great interest. One hopes the authors will have an opportunity to continue their studies using controls where no antibiotic treatment or prophylaxis is employed (and also examining the stools for staphylococci), and relying purely on disinfectant measures and conservative treatment.

Viability of E. coli treated with heat or chlorine

Resuscitation of debilitated organisms, particularly after enduring some not completely effective sterilising process, is now causing interest. It is known that *Streptomyces griseus* cells "killed" by exposure to u.v. light can be reactivated by exposure to visible light. A similar phenomenon has been observed in the case of *Esch. coli*, and it was found that incubation in metabolites like sodium pyruvate could bring about reactivation. In 1954, further studies indicated that *Esch. coli* "killed" by exposure to heat or chlorine could be reactivated. In 1955 this view was challenged and the worker concerned concluded "it is important to know whether bacteria can be reactivated after treatment with disinfectants; no evidence so far available proves that, in fact, they can be."

Further work has now been done.[5] The term "inactivation" has been used to indicate the loss of ability of the cells to multiply when incubated in a favourable medium, and "reactivation" means regaining the ability to reproduce in a favourable medium. The test culture was *Esch. coli* strain B/r, the media were simple metabolite solutions of pyruvate, citrate, oxalacetic acid, lactic acid, malic acid and a mixture of eleven metabolites. For controls very small initial inocula were used, less than 20 organisms, and further controls were put up in M/10 phosphate buffer without metabolite.

After incubation of controls, all metabolites showed significant multiplication of organisms, but there was only a relatively small increase in the buffer solutions. Suitably inoculated tubes were exposed to heat ranging over 71°C. to 56°C. and for times varying from 30 sec. to 35 min. Results of these tests showed that suspensions heated to 71°C. for 30 sec. were killed, there being no growth subsequently in the various metabolite media. Tests at 62°C. and 56°C. showed varying casualty rates, and subsequent multiplication numbers in metabolite media indicated that only a relatively small proportion of survivors had grown in these media.

Large bacterial populations were exposed to 1 p.p.m. and 0·5 p.p.m. available chlorine for 30 sec. contact times and various quantities from 4 ml. to 0·004 ml. of chlorine-exposed material were inoculated into various metabolite media. In suitably arranged experiments where a few organisms survived chlorine exposure, incubation in metabolites produced large increases in the number of viable organisms. The authors observe that this investigation does not indicate that the weak nutrients used can rehabilitate the bacterial metabolic cycle, and conclude that where multiplication in metabolite media occurred this was the result of surviving organisms rather than reactivation of "killed" organisms.

Not everyone will agree with the experimental methods used, and possibly from the data presented more conclusions might be hazarded. It is to be hoped that this paper will promote further

(*Continued on page* 214)

BOOK REVIEWS

Dangerous Properties of Industrial Materials

By N. Irving Sax. New York: Reinhold; London: Chapman and Hall Ltd. Pp. 1,467. 180*s. net.*

THE size of this volume (it is 7¼ in. wide, 10¼ in. deep and 2½ in. thick) makes one realize the very large number of dangerous substances which are handled on the industrial scale, but it also gives one the consolation of knowing that already very much must be known of the hazards that lurk therein. This book is monumental in the American tradition, but its arrangement and careful editing make it a valuable and easily used work.

Apart from the alphabetical list of materials, in which the alternative names are made foolproof by cross-indexing, there are excellent chapters on general toxicology, ventilation control, personnel protection and hygiene, atmospheric pollution, radiation hazards, industrial fire protection, storage and handling of hazardous materials, reactor safeguards, allergies and shipping regulations.

There is a very topical chapter on reactor safeguards which contains not only general principles but a wealth of information in the form of tables and graphs. Every type of hazard arising from nuclear work appears to have been covered. Taken in conjunction with the chapter on radiation hazards, this section will form a very valuable source-book on atomic dangers other than those encountered in warfare.

This book is expensive, but it deserves a place in every factory where there are hazards from dangerous materials. It would not be out of place in the college, university, and research laboratory.

F. P.

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Industrial Chemicals

By W. L. Faith, D. B. Keyes and R. L. Clark. Wiley. Pp. 844. 128*s.*

IN SPITE of the title this book is concerned only with chemicals produced in the United States. In the second edition the authors have added several chemicals and have systematically brought up to date those items already in the first edition. An admirable, very brief outline of the actual processes in commercial operation is given together with the details of the production and price during the last 20 years. Some 140 chemical manufactures are described of which about 90 are concerned with carbon compounds. When appropriate more than one route is described, but unfortunately the authors are rarely able to indicate the relative advantages of each process. However, in certain cases such data can be obtained from the very interesting "use pattern" of the chemicals.

One wonders how accurate these use pattern percentages are; *e.g.* 2½% of the 1955 production of acetylene, 8,000 million cu. ft. (550 million lb.) is used, according to the authors, for the production of acetic acid, acetaldehyde, polyvinyl alcohol and vinyl acetate. Now, since the production of acetaldehyde is given as 800 million lb., one is led to the opinion that the use of acetylene in this way is small compared with that from other sources; be this as it may, this route is listed first in the three methods given.

On the whole the selection of items for inclusion in the book is good, but there are anomalies. Thus the weedkiller 2 : 4-D (2 : 4-dichlorphenoxy-acetic acid) is one of the 140 chemicals listed, but the principal starting materials, monochloracetic acid and 2 : 4-dichlorphenol, are not.

The chemical industry now plays such an important and diverse part in the economy of the world that it is difficult to grasp the relative interdependence of one chemical on another. One could expect that a book with this title and comparatively high cost should attempt to give some assistance in this direction, but it is completely disappointing in this respect; not a chart, not a diagram, helps the reader—what a missed opportunity! It is true the use pattern gives a certain amount of assistance, but one has to take pencil and paper and a lot of time to obtain an overall picture.

The dependence of the American organic chemical industry on petroleum and natural gases as basic raw materials is apparent, and since the chemical industry in Great Britain is following a similar trend the book may well be of value to some readers here.

The authors state that much of the data was compiled from Kirk and Othmer's "Encyclopaedia of Chemical Technology," *Chemical Week* and *Chemical and Engineering News.*

It is to be regretted that the detailed references are not given.

I think the book is expensive, as much of the data can be found in the sources above. Perhaps the high standard of printing and the large number of graphs and flow diagrams are partly responsible for the high price.

B. J. HEYWOOD.

Inorganic Syntheses

Vol. V. Edited by T. Moeller. McGraw-Hill. 1957. *Pp.* 265 *inc. index.* 46*s.* 6*d. net.*

THIS series of volumes presents detailed and tested methods for the synthesis of inorganic compounds. It includes critical details essential to the success of a synthesis. Contributions come from many countries and it is a rigid policy to have each synthesis checked in at least one independent laboratory. As in earlier volumes the syntheses in Vol. V are arranged by chapters on the basis of the Mendeleev periodic classification. They include metals like beryllium, uranium, cobalt, platinum and titanium, organosilane compounds, rare earths, organogermanium compounds and several other compounds of current interest. There are indexes of contributors, subject matter and formulæ.

PLANT AND EQUIPMENT

High Vacuum Crystallisers

Last year Courtaulds Ltd. placed with the Kestner Evaporator and Engineering Co. Ltd. an order for two high vacuum crystallisers. These will be installed at Courtaulds' works at Preston and are of the Kestner continuous high vacuum type. Each is designed to crystallise out many tons of Glauber's salt per 24-hr. day from rayon spinning bath liquor. The liquor will be cooled to as low as 5°C. by flash evaporation. The high vacuum ueeded will be obtained by means of steam-operated vacuum augmenters followed by barometric condensers and two-stage air ejectors.

Constructional materials of the plant will include a high proportion of Kestner's corrosion-proof material Keebush, with other parts in rubber and lead-lined mild steel.

Smoke Density Devices

A. M. Lock and Co. Ltd. have improved the design of several of their smoke density instruments to assist industries in tackling the problems of "dark smoke" and fuel wastage.

The simple smoke alarm, type SA1 is suitable for chimneys up to 10 ft. dia. and gives an alarm when the smoke passing up the stack exceeds a preset amount. The SA1 control unit is housed in a dust-tight cast aluminium case and can be mounted up to 100 ft. from the light projector and receiver units which are mounted on the stack in weatherproofed housings. Two alarm recorders are available for use with this simple smoke alarm, a spring-driven model which has a chart lasting 24 hr., and an electrically powered one in which the chart lasts seven days.

The smoke density indicator MF2 provides for remote indication and recording of smoke density, as well as an alarm when "dark smoke" is emitted. Many useful features are provided on this new equipment, such as a completely interchangeable plug-in electronic chassis in the control unit, an easily accessible terminal connection panel, and a dust-tight cast aluminium case with a hinged door together with a lock and hinged chassis.

Quickfit and Quartz Ltd. are increasing production of their laboratory glassware by the introduction of new plant and mechanised layout. Semi-automatic grinders are increasing productivity to between four and five times compared with the hand-grinding process. Conical joints are finished much faster and have profile accuracies to within 0·0001 in. The photograph shows a Shelley electric oven which was designed to simplify and improve annealing of their heavy chemical glassware. With overall dimensions of approximately 12 ft. by 6 ft. by 6 ft. and weighing 3 tons the oven can readily be lowered over a new batch of glassware while completed pieces cool.

In the company's light receiver and projector, the careful mechanical design of the new stack units has even further reduced effects of dust and soot deposits and a double hinge arrangement allows easy access to the lamp, photocell and lenses.

These two instruments built to the relevant British Standards specification cover the needs of small and large chimneys and are claimed to comply with the requirements of the Clean Air Act economically.

Full details of these two latest smoke meters and alarms are available, and information will be sent by the firm to anyone who is responsible for industrial plant which is capable of emitting smoke.

Prices of the instruments range from £65.

Automatic Fire Detection

There is on the market a wide selection of automatic fire detection systems. Three of these, the Pearson, May-Oatway and National Tubular systems, which have the approval of the Fire Offices Committee, work as follows.

Detectors are positioned throughout a building and arranged in "circuits" so that any outbreak of fire would signal on an indicator panel the exact position of the outbreak and, at the same time, submit a signal direct to the public fire station. Every part of the premises protected is therefore not only in continuous communication with the local fire brigade, but no human factor enters into the safeguard.

The Pearson Detector, one of the most commonly used, is an oblong cast box approximately 5 in. by 2 in. by 3 in., on the underside of which, and fixed rigidly to it at either end, are two curved metal strips. One strip is thicker than the other. In the centre of each strip is fixed a metal pin, insulated by an ivory tip at the upper end. The two pins pass into the interior of the casting through packed glands, which protect the interior from dust and moisture, while leaving the strips free to move under the influence of heat. Inside the casting is mounted a porcelain base. Carried on this base are two electric contacts, one of which is controlled

by the metal pin attached to the thick strip and the other by the pin attached to the thin strip.

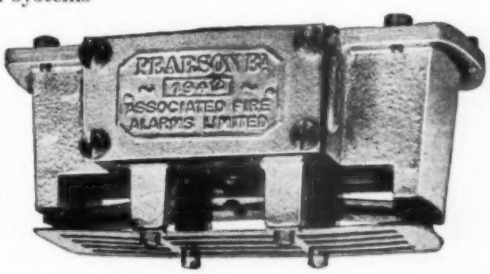
On a sudden increase in temperature the thin strip expands rapidly causing the two contacts in the casting to come together and make an electric circuit, thereby giving the alarm. In the event of normal temperature changes the instrument is self-compensating, the two strips expanding equally (the thicker metal having time to absorb the heat and expand as much as the thinner strip). To safeguard against a gradual or smouldering fire a limit stop is set above the two contacts to ensure that a call is given at a predetermined temperature, irrespective of the rate of rise.

The Pearson Detector is also obtainable in a flush fitting form; in this case only a small grille is visible on the ceiling, the surface of which can be painted to any colour blending in with the ceiling.

With the Pearson, May-Oatway and National Tubular systems a common wiring principle is used, the circuits being arranged in "ring" form. The principal advantage of this method is that it allows the whole of the wiring, together with the alarm receiving, sounding and signalling equipment, to be tested daily without the necessity for application of heat to the detectors. A further important advantage is that the system is not rendered inoperative by a break in the wiring; should a break occur it will be revealed at the time of the daily test.

Signalling to the fire station, which is entirely automatic, is carried out over a pair of G.P.O. lines; the two wires are used as one, the return path for the electric current being by way of earth. One of the advantages of this method of using G.P.O. lines is that "crossing" of the pair, which often occurs in test rooms, does not affect the operation of the system; another is that, again, a break in one wire does not render the system inoperative.

Indicators for the reception of calls from F.O.C. approved systems are installed in all the principal fire stations in Great Britain, and these and the large number of installations connected to them are regularly serviced by the makers.



The Pearson fire detector

Rotascreen bottle printing machine with a stated output of 2,500 impressions per hour

Bottle Printing Machine

Glass and polyethylene bottles and jars, pots and tins can be printed at speeds of up to 2,500 impressions per hr. on the SPS Rotameter, a German screen printer now being marketed in Britain.

It is a fully automatic machine and can be used for containers varying in diameter from $\frac{3}{4}$ in. to 3 in. and in length from $3\frac{1}{8}$ in. to $11\frac{3}{4}$ in. A servo-motor provides automatic centring and automatic feed is incorporated by star feeder. Stencils can be retouched without affecting the register.

An additional hand feeding attachment allows flexible containers to be printed on the machine. This unit gives feeding, printing, and delivery without intermission. The SPS Rotascreen bottle printing machine works from a 220 v. single phase motor using 90 watts. The space required is 24 in. by 16 in. overall plus conveyor delivery arrangements provided by the consumer. Net weight is approximately 180 lb. Output is said to be up to 2,500 impressions an hour.

Also available is the SPS Minor, a fully automatic machine for screen printing on inflexible plastic packs, pharmaceutical containers, components, or similar items. It is reported to give excellent reproduction on both round or square containers up to a maximum depth of 1 in. and a maximum size of $4\frac{3}{4}$ in. by $4\frac{1}{2}$ in.

Articles are automatically fed into the machine on a hopper principle and according to the makers, speeds up to 2,000 to 3,000 an hr. may be obtained.

Gate Type High Vacuum Valves

A new series of gate type high vacuum valves, whose full-opening design with a straight-through unrestricted flow and a very short flow path provides maximum conductance, has been introduced by F. J. Stokes Corporation.

The company claim the new valves may be installed in any position, and sealed vacuum tight against atmospheric pressure in either direction. The tight seal is maintained regardless of the length of time the valve has been in service by virtue of the special design of the mechanism which seats the valve plate. The plate is guided by rollers and connected to a follower carriage through two hinged links; as a result, scuffing of the gate sealing gasket by repeated opening and closing of the valve plate is impossible.

Three types of actuation are offered: pneumatic, handwheel and quick-acting toggle lever.

The new valves are available in 2 in., 3 in., 4 in. and 6 in. sizes. Larger sizes will be built to order.

NOTES AND NOTIONS

DYNAMITE

THE newspapers report clinical trials of a progestogen pill that is said to have prevented conception in a number of Costa Rican women for a trial period of many months, the mechanism being the upsetting of the normal œstrogen/progestogen cycle. Clearly a lot of money and effort is being put into the quest for pills to simplify what is delicately called family planning. The prize is great and the race is fierce. The winners will make several fortunes.

Suppose this Huxleyian fantasy comes true. What a first-class row these little pills would provoke. Doctors, politicians and churchmen would all enter the lists. Parliament, hitherto reticent on these matters, would have to pronounce judgment on an issue loaded with ethical and moral dynamite. And what of the impact upon the National Health Service? How could doctors refuse free pills to patients clamouring for supplies on all sorts of medical and economic grounds? Who could *not* argue that a free supply of pills (perhaps one a day *ad infinitum*) was essential for her health and wellbeing? And how could the N.H.S. stand up to the additional massive burden thus imposed on it?

With these thoughts in mind it is easy to hope that oral contraception never becomes possible. But the pills could prove a blessing to overcrowded, underfed nations like India and China. Contraceptive pills might pose for the West problems as acute as those raised by the H-bomb. Both are literally matters of life and death.

THE PRINTED WORD

A CERTAIN pessimistic professor of chemistry used to warn his students against blind acceptance of any statement in the textbooks. Errors, he said, constantly crept in and seldom crept out, being repeated from book to book.

One such example was an unusual organic synthesis, long reported as pink until a later preparation brought out the fact that the original experimenter was colour blind.

Another example, quoted in a recent publication, relates to the hippopotamus being oft-quoted as having no cholesterol in its bile, unlike other animals. This apparently arose from a dash being interpreted as "nil" instead of "no information." Curiously enough, the author who makes this error refers elsewhere on several occasions to "Petrie dishes." This spelling often crops up, and one textbook refers to the circular glass dishes "invented by a Scotsman called Petrie." The truth, so far as I can ascertain it, is that they were developed by R. J. Petri, an Italian student of Robert Koch, and that they are still used for "plate cultures" because originally such cultures were made on a flat glass plate.

FRYERS IN A STEW

THE activities of that progressive body, the British Deep Fat Frying Research Association, are chronicled by the scientific correspondent of the *Manchester Guardian*. Among its startling discoveries, recorded in "Fish and Chips 1957," is a new oil which imparts to chips a crisp brown texture in as little as two seconds at 830°C.; it is made by dialytic concentration from the residues of holds of oil tankers plying to the Persian Gulf *via* the Cape (the route taken is evidently a critical factor in quality). Then there is the observation that deep-frozen chips have shown a tendency to mechanical failure during resuscitation. One consignment flown to New York turned into a light blue granular powder when thawed out. It may have some value as a thermal insulant.

The Deep Fat Fryers are not lagging in the application of the very latest techniques. Hence the construction of a fryer contained in a lead wall 4·7 ft. thick for studying the influence of highly ionising radiations on the deep fat frying process.

It is gratifying to note the concentration of scientific skills and resources being put into the manifold problems of frying fish and chips. The *Manchester Guardian's* correspondent is to be congratulated. I look forward to his reports on the work of the Bootlace Study Group (a section of the Tubular Fabrics Research Association) and the Gut Substitute and Synthetic Filaments Research Association, to name but a few.

WHEY FACES

A MILK and roses complexion must be the aim of every woman. However, she would feel much less flattered to be called "whey faced." This prejudice may be overcome if a new idea in skin treatment is successful. It is the incorporation of whey in skin cream for the purpose, it is claimed, of softening the skin and healing minor irritations and blemishes. The reasoning is that lactic acid bacteria contain small amounts of amino acids, enzymes and vitamins. The culture may even contain antibiotics. A French patent (1,096,421) covering the use of *ferments lactiques* in face creams has been issued to Helena Rubinstein. How a culture of *Lactobacilli* is more beneficial to the skin than a cream acidified with lactic acid is not known. It may be, as pointed out in Schimmel Briefs, that some of the minor metabolic products of the lactic acid bacteria may benefit the skin in a manner now unsuspected.

I suspect that *Lactobacilli*, like Royal Jelly, vitamins, hormones and the rest of the many ingredients proposed at one time or another as cosmetic materials, simply illustrates our general ignorance of the biochemistry of the skin. Of course milk is a time-honoured beauty treatment and it is true that it can yield the antibiotic nisin. But the microbiological approach is tricky and what may work on one person might well be useless on another. Still, if your wife cannot afford to bathe in milk, a face cream containing whey might be a cheap substitute.

Cicerone

DISINFECTANTS

(*Continued from page* 210)

work on the precise fate under various conditions of bacteria wounded in the lists of sterilisation.

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News . . .

I.C.I. have spent £305 m. on new plant in ten years

DURING 1957 I.C.I. spent £50·6 million on new plant, equipment and building, bringing their total capital expenditure for the last 10 years to £305 million. Many new projects have been authorised for this year, including the expansion of Terylene and nitro-chalk capacity, acrylonitrile manufacture and a further carbonylation plant.

These facts are given in the annual report for 1957 which records the highest sales in the company's history—£310·6 million against £291·5 million in 1956. This is particularly notable because up until June last the company operated a standstill on the prices of its major products and, indeed, reduced the prices of others. Exports also rose—to £76·6 million compared with £73·1 million in 1956. A big export contribution was made by sulphate of ammonia. Subsidiary and associated manufacturing companies abroad continue to expand, particularly in Canada, Australia, India, South Africa and Argentina. However, the project for making methyl methacrylate in the U.S. in association with Hercules was abandoned.

A major organisational change in 1957 was the splitting off of part of the Billingham Division to form a Heavy Organic Chemicals Division, petroleum being its primary raw material.

Research and development continued at a high level; the 1957 figure for research expenditure being about £8·5 million and for development £5 million.

The number of employees rose during the year to 115,846, nearly 400 more than in 1956.

Cheaper tin boxes

The Metal Box Co. Ltd. warmly welcomes the reduction of price of tinplate which has been announced by the Iron and Steel Board and the introduction of the new schedule which is more realistic and will allow greater economies in manufacturing orders.

The company believes that this announcement will have an encouraging effect on the tin box industry, which has suffered so long from rising costs of materials. It proposes passing on the advantage in full and immediately to its customers.

Cheaper silicones

Midland Silicones Ltd. have made substantial cuts in the home trade prices of their MS200 silicone fluids and their *Releasil* fluid.

Price cuts for MS200 fluids in the viscosity range of 50cS to 1,000cS range from 1s. 3d. per lb. to 1s. 6d. per lb. according to quantity. Larger cuts have been made for fluids of other viscosities in the range of 0·65cS to 20cS and of 12,500cS and up.

Price cuts of *Releasil* fluid will save buyers up to 1s. 6d. per lb. according to quantity.

These reductions have been made possible as a result of increased production, and therefore lower operating costs at the company's plant at Barry, Glamorgan; the last major price reductions made by the company for these products took place in 1956.

Substantial markets for silicone fluids exist in the polish, pharmaceutical, paint and engineering industries.

Chemical duty drawback

The Treasury have made the Import Duties (Drawback) (No. 8) Order, 1958, and the Safeguarding of Industries (Drawback) (No. 1) Order, 1958, which provide for the payment of drawback of Customs duty on *iso*valeric acid used in the manufacture of exported bromvalerone and on α-ethylbutyric acid used in the manufacture of exported carbromal and acetylcarbromal.

Bush sell American company

W. J. Bush and Co. Ltd. have sold their U.S. subsidiary company, W. J. Bush and Co. Inc., to R. D. Webb and Co. Inc. The trademarks and the right to use the name "W. J. Bush" have not been included in the sale.

W. J. Bush and Co. Ltd., who have a substantial majority shareholding in the American company, will devote their proceeds of the sale to the continued development of their business.

In the opinion of the board the nature of the business of W. J. Bush and Co. Inc. was proving incompatible with the wider and more profitable operations undertaken by the Bush Group throughout the world and therefore a favourable opportunity has been taken to effect a sale.

The name of "W. J. Bush" and trademarks have been taken over by a new company under the continuing name of W. J. Bush and Co. Inc., which has been incorporated in the State of Delaware in the United States. This company will not undertake any manufacturing processes, but the Bush Group will continue to develop appropriate business in the United States on an import basis.

Fisons/Geigy link-up on agricultural chemicals

Fisons Pest Control Ltd. and the Geigy Co. Ltd., sole concessionaires in the U.K. of J. R. Geigy S.A. of Basle, have concluded an agreement for the co-ordination of all aspects of research, optimum usage of manufacturing facilities, and a fusion of marketing and distributive services in the fields of agricultural and horticultural chemicals.

The agreement is the result of over twelve months of negotiations.

Fisons Pest Control are associated with pioneer work in agricultural chemicals, particularly herbicides. The development of Fisons 18-15 selective weedkiller is the most recent example of their work. Geigy are known for their original discoveries in the insecticide field, of which the most outstanding was DDT. Two recent Geigy discoveries have been the insecticide diazinon and the weedkiller simazine.

The entire range of Geigy agricultural and horticultural products apart from DDT itself will now be marketed in the U.K. by Fisons Pest Control organisation. This, together with F.P.C.L. existing chemicals, will make it the most complete range of crop protection products in this country.

More methanol

The Billingham Division of I.C.I. is to increase substantially the capacity of the methanol plant at its Heysham works, subject to planning permission being obtained. Demand for methanol is growing steadily and this extension is designed to ensure adequate supplies of this important chemical for some time to come.

One of the main uses of methanol is for the manufacture of formaldehyde which, in combination with substances such as urea, phenol and melamine, provides plastic materials which fulfil many purposes. They give non-crease and non-iron properties to textiles, provide special adhesives for wood and metals, and are moulded into the numerous articles so familiar in the modern home and office. In addition, methanol is widely used within I.C.I. itself—for example, for production of *Perspex*, alkylamines and *Terylene*.

The plant to be installed will be similar to that already at Heysham, but in a more modern form with automatic control equipment. Construction will take about two years.

Company finance

William Gossage and Sons Ltd. Net profit for 1957 amounted to £186,482 after taxation (£196,327 in 1956). Deductions of £40,969 for preference shares and £140,000 for proposed ordinary shares leaves a profit of £5,513 to be retained in the business.

People

Mr. J. D. Tennant, the Controller of the Borax (Holdings) Group, has been appointed to the board.

Mr. G. H. Black, a director of the Kestner Evaporator and Engineering Co. Ltd., will fly on a visit to the United States in a few weeks' time.

Dr. Forrest F. Musgrave, F.R.I.C., has been appointed personal assistant to Mr. Sydney Barratt, chairman of the Albright and Wilson group of companies. Dr. Musgrave was formerly managing director of Lubrizol Great Britain Ltd. He is a Canadian.

Smith Kline and French Laboratories Ltd. announce that **Mr. W. F. Hodson,** head of the medical promotion division, and **Dr. A. H. Ratcliffe,** M.A., D.PHIL., head of the research and development division, have been elected directors.

Mr. R. P. Wright has joined Newton Chambers and Co. Ltd. as Izal factory manager. The vacancy was caused by the death of **Mr. J. Connell.** Mr. Wright has been production superintendent in the Textile Processing departments of British Enka, Aintree, which company he joined in 1954 as a maintenance control engineer.

Mr. S. H. Clarke, C.B.E., M.SC., has been appointed director of the new research station now being built for the D.S.I.R. at Stevenage for fuel and process research. The programme of the new station will include, as major items, researches on atmospheric pollution, the production of oil from coal and aspects of mineral processing.

Mr. Clarke is 54. He was appointed the first director of Fire Research in 1946 when the Joint Fire Research Organisation of the D.S.I.R. and the Fire Offices Committee was set up. The date on which he will take up his new appointment at Stevenage will be announced later.

Mr. B. D. Thornley, chairman and managing director of Benger's Ltd. and Benger Laboratories Ltd., has announced the formation of a new board of directors for the two companies.

New members of the board are **Mr. F. Fowler,** F.P.S., A.R.I.C. (technical director), **Mr. J. P. Sutton,** (company secretary) and **Mr. C. R. B. Williamson** (sales director). They join Mr. Thornley and Dr. L. Golberg (research director). Mr. Fowler has been with Benger since 1946; before then he was engaged in synthetic drug manufacture with British Schering Ltd. Mr. Sutton joined Genatosan, an associated company, in 1932. At 32 Mr. Williamson is the youngest of the three new directors. He joined the Fisons Group of Companies in 1946 as an assistant pharmacologist, moving to Benger in 1950 as a marketing executive. From 1954 to 1956 he was marketing and publicity manager of Pfizer Ltd. and then returned to Benger as marketing controller.

O. N. Williams.

C. Williamson.

D. A. Hubbard.

J. P. Sutton.

A New Zealander, **Mr. O. N. Williams,** has been appointed managing director of Cyanamid of Great Britain.

For the past six years Mr. Williams has been a Cyanamid director, and also general manager of the company's Lederle Laboratories Division in this country. He succeeds **Mr. Raymond E. Lapean,** who has been appointed regional director of Cyanamid in Europe. Mr. Williams came to London from Montreal, where he was Cyanamid's Canadian assistant regional manager. He previously worked in Southern California in the Lederle sales organisation.

Mr. D. A. Hubbard has been appointed a director of Aero Research Ltd., a Ciba company. He joined Aero Research Ltd. in 1939 and shortly afterwards took charge of production. In 1947 he was appointed works manager with special responsibility for the planning and commissioning of the large-scale production plants which have been erected at Duxford since that time.

The Cambridge Instrument Co. Ltd. has appointed **Mr. L. F. Cooke** as commercial sales manager. **Mr. S. A. Bergen,** M.I.E.E., is the new chief development engineer of the Cambridge organisation.

Mr. A. E. V. Houchen, managing director of County Laboratories Ltd., and **Mr. A. C. Fabricius,** managing director of Beecham Overseas Ltd., have been appointed to the board of Beecham Group Ltd. Both companies are subsidiaries of the Group and Mr. Houchen and Mr. Fabricius are retaining their respective managing directorships.

Mr. C. L. Ricketts, managing director of the Elephant Chemical Co. Ltd. Barmouth, Merioneth, and of the Welsh Perfumery Co., was recently installed as President of the Industrial Association of Wales and Monmouthshire.

Mr. Brian H. Turpin, managing director of Q.V.F. Ltd., has been appointed managing director of Quickfit and Quartz Ltd. Both companies are members of the Triplex group of companies. Mr. Turpin joined Quickfit and Quartz in 1937 as technical manager. **Mr. J. D. Nuttall,** director and secretary of the parent company, the Triplex Safety Glass Co. Ltd., has resigned from the board of Quickfit and Quartz.

Mr. M. J. Smith, overseas trade director of Evans Medical Supplies Ltd., recently left London Airport for New York. He is making a short visit to Central America and Venezuela and will include in his itinerary Jamaica, Cuba and Mexico. The object of his visit is to study conditions in those countries as they affect the pharmaceutical export trade of the United Kingdom. He will return on May 15.

Mr. Desmond Abel Smith has resigned his appointment as chairman of Borax (Holdings) Ltd., after 20 years in that office, but remains on the board. **Lord Clitheroe,** who has been a director for 11 years and deputy chairman for the last 3 years, has now been elected chairman, and **Mr. Frederick A. Lesser** has succeeded Lord Clitheroe as deputy chairman whilst continuing to occupy the position of managing director.

Mr. Stewart M. Ritchie, who has been public relations officer and medical promotion administration manager with Smith Kline and French Laboratories Ltd. for some years, has been appointed assistant manager with Intercontinental Marketing Services Ltd. **Mr. I. Gellman,** B.SC., who has been head of the market information department at SKF since 1954, succeeds Mr. Ritchie as medical promotion administration manager.

Mr. E. M. Fraser, C.B.E., sales controller of Imperial Chemical Industries Ltd., retired on March 31, 1958, after over 38 years' service with the company and its predecessors. **Mr. J. H. Townsend,** at present deputy sales controller of I.C.I., has succeeded Mr. Fraser.

Mr. H. F. Wilson, B.SC., A.R.I.C., has been appointed a director of the Telegraph Construction and Maintenance Co. Ltd., and will shortly become managing director of the Telcon Cables Group. He was formerly chief chemist of the company and later technical manager. **Mr. L. G. Fairfield,** M.A., M.I.E.E., has been appointed commercial director of the company.

For achievements in industry, **Mr. F. A. S. Wood,** 31-year-old managing director of Croda Ltd., has been made an Honorary Texan. Croda have associate companies in the U.S. and Italy. Other Hon. Texans announced recently from Fort Worth, Texas, are Sir Winston Churchill and Lord Chandos. Hon. Texanship is awarded to people who have been outstanding in their particular field and who help to foster Anglo-American relations.

Obituary

Mr. Bernard John Hewlett, sales director of Fisher's Foils Ltd., died on April 3 at the age of 49. He joined the company in 1929.

Pfizer appointments

The establishment of new chemical and pharmacological research units at Sandwich, Kent, is announced by Pfizer Ltd. Recent appointments to the research staff include:

Dr. H. H. R. Reinert becomes head of the pharmacological research unit. Before joining Pfizer he was senior pharmacologist at Glaxo Laboratories.

Dr. P. B. Stones becomes the company's chief virologist. His experience includes seven years in the Colonial Service, working on bacteriological and virus infections in Nigeria. Since 1952 he has been lecturer in bacteriology at Manchester University.

R. E. H. Swayne, B.SC., PH.D., has taken up duties as Research Liaison Manager. He will be responsible for contact with academic and other institutions in the U.K. and Europe, and also between the research departments of Pfizer in this country and the United States.

Recently appointed as research chemists are: Dr. W. H. Hunter, Mr. W. C. Austin, who joins the company from Allen and Hanburys Ltd., and Dr. C. R. Worthing.

Head of chemical research is Dr. R. J. Boscott, who was lecturer in endocrinology at Birmingham University before joining Pfizer in March last year.

British Medicine "Finest and Cheapest"

IT IS difficult to remember an annual dinner of the Association of British Pharmaceutical Industry at which the cost of drugs to the N.H.S. was not referred to by the president of the day and the chief guest. This year's dinner, held at the Savoy Hotel, London, on April 30, proved to be no exception. Nevertheless, the president, Dr. Thomas Kerfoot, contrived to say the same things in a refreshingly different way and his remarks, including Latin quotations, were very well received.

British medicine, he robustly declared, was the finest and cheapest in the world. A survey had been carried out for the Association into the trend of prices of proprietary preparations not advertised to the public. The price level of a fully representative sample of these products decreased from 1953 to 1957 by 18% at a time when prices of other goods were increasing.

Of the drugs in common use today, about 90% were unknown twenty years ago and a very great many were unknown ten years ago when the National Health Service was started. These new drugs had been of inestimable value to the community: "It costs not less than £3 per day to keep a patient in hospital; an average hospital stay costs something over £30. If an additional expenditure of 30s. or £2 gets a patient out of hospital one day sooner, or if the use of £5 worth of drugs keeps him out of hospital altogether, surely the money is well spent. Of the £74 million which it is estimated will be spent this financial year on the Pharmaceutical Services £43 million will be paid to the industry, and I venture to suggest that that £43 million might well be about the best investment this country ever made.

"If we succeed in conquering diseases so far out of our reach and it costs another ten million on the drug bill, shall we again be told that 'something has got to be done to stop this appalling waste of money'? I hope not. Rather, I hope it will be said that the industry is doing a good job; let it continue to do a good job."

Replying to Dr. Kerfoot, the Parliamentary Secretary to the Ministry of Health, Mr. R. H. M. Thompson, who came at the last minute in place of the Minister, Mr. Walker-Smith who was detained by pressure of work, said that he was glad the industry was now doing more to publicise itself. Last year the former Minister of Health had advised the Association to do something about publicity and now it had a public relations committee and a firm of press consultants working for it.

Of course the Minister recognised all the points put forward by Dr. Kerfoot concerning hospitalisation costs, research costs, exports and so on. But it had to be remembered that the N.H.S. was run with public money—£740 million this year—so the Minister was compelled to watch every pound. It was pleasant to recall that the investigation into pharmaceutical prices had revealed nothing untoward. He was sure the industry was working for the common good.

Sandoz to centralise production

A pharmaceutical factory is being built by Sandoz Products Ltd. at Horsforth, near Leeds, to replace the existing plant at Stonebridge Park, London. It is due to be completed next year.

Sandoz are building a number of plants on the site at Calverley Lane, Horsforth, with the object of concentrating there all their manufacturing operations and laboratories. Already they have completed a dyestuffs plant which replaces plants at Manchester and Bradford. Since 1951 Cotopa Ltd., an associated company specialising in the acetylation of cotton and wool, have been operating a factory at Horsforth.

By 1960 Sandoz hope to have completed an administrative and laboratory building to replace their premises at Bradford. At the same time they expect to finish service buildings serving the whole Horsforth site and comprising canteen, workshops, garage, gatehouse and boilerhouse. The final project on the present programme is a factory for making chemical textile auxiliaries. When completed in 1962 it will replace the present factory at Bradford.

MEETINGS

Chemical Society

June 5. "The History of the Isoprene Rule," by Prof. Ruzicka. 7.30 p.m. Rooms of the Society, Burlington House, Piccadilly, London, W.1.

Society of Chemical Industry

Agriculture Group

June 10. Annual summer meeting. Levington Research Station, Levington, near Ipswich.

Chemical Engineering Group

June 10. "Glass as a Material of Construction in the Chemical Industry," by J. McN. Bruce. 5.30 p.m. 14 Belgrave Square, London, S.W.1.

Pesticides Group

June 27. Summer visit. Chesterford Park Research Station.

New SKF factory

Smith, Kline and French Laboratories Ltd. are planning to build a factory at Welwyn Garden City, Herts., at an estimated cost of £500,000.

Tidiness in the works

With "Works tidiness" as its theme the National Industrial Safety Conference of the Royal Society for the Prevention of Accidents took place at Scarborough from May 9-11.

Running concurrently was a Trade Exhibition at which 50 manufacturers of safety appliances exhibited.

Distillers' chemical division

The Distillers Co. Ltd. have merged their Carbon Dioxide, Industrial Alcohol and British Industrial Solvents Divisions into a single Chemical Division with HQ at Devonshire House, Mayfair Place, Piccadilly, London, W.1. The effect of this will be to centralise management, production, control, purchasing and accounting, but sales will continue to be handled by separate departments.

Standards experts to meet in Harrogate

Several hundred industrial leaders, engineers, scientists and other specialists from 40 countries are to meet in Harrogate in June for the 1958 assembly of the International Organisation for Standardisation. It will be the first time the ISO assembly has been held in Britain; previous meetings were at Stockholm, New York and Paris. The meetings will be opened on June 9 by ISO's president, Sir Roger Duncalfe, and they will end on June 21. Arrangements are in the hands of the British Standards Institution.

Chemical executives tour Germany

Five senior executives from the chemical industry were among a party which last month made a two-week tour of German industry organised by the Industrial Welfare Society.

Four of them were from I.C.I.: Mr. F. W. C. Hinton, technical officer (mechanical)-power engineer of the Alkali Division, Mr. B. T. Jenkins, labour manager of Wilton works, Mr. Robert N. Kerr, works manager of the General Chemicals Division, and Mr. E. I. Perks, assistant labour manager of the Billingham Division. The fifth was Mr. C. A. Joshi, industrial engineer, Tata Chemicals Ltd., Bombay.

The aim of the tour was to study the human and social implications of technological change. Visits were made to factories manufacturing detergents, cookers and refrigerators, motor vehicles, steel tubes, carpets and vacuum cleaners.

Pharmaceutical Congress

It is expected that about 200 French and British delegates will participate in the Franco-British Pharmaceutical Congress which is being held at the Hotel Hydro, Peebles, from June 13-16.

Before the Congress delegates will make tours of Scotland.

Application forms may be obtained from the Hon. Secretary of the Franco-British Pharmaceutical Commission, 36 York Place, Edinburgh 1, or from the Secretary of the Commission, at 17 Bloomsbury Square, London, W.C.1.

I.C.I. increase output of alkylated phenols

A new plant is being built by I.C.I.'s Heavy Organic Chemical Division at Billingham, Co. Durham, for the extended production of octylphenol and other alkylated phenols. I.C.I. already plays a major part in the manufacture of these chemicals.

For many years I.C.I. has manufactured octylphenol, an important raw material for the manufacture of lubricating oil additives, detergents and paint resins. Nonylphenol is now also in production, and has recently been added to the sales range. It is used in the manufacture of detergents, oil additives and rubber chemicals. Further products are being developed.

The ability to manufacture these intermediates on a large scale will greatly help the U.K.'s export drive.

I.C.I. has recently announced a substantial reduction in its home trade price for octylphenol to a level which is closely comparable with the U.S. domestic price.

Fuel saved in drying plant

In his report to the board of the National Industrial Fuel Efficiency Service for the week ending February 22, Dr. W. Angus MacFarlane, chief executive, gave examples of some of the services carried out by the N.I.F.E.S., resulting in improved fuel efficiency in many industries.

One such test was carried out in May of last year on an oil-fired rotary fertiliser dryer at the plant of Robert Stephenson and Son Ltd., Beverley. As a result the combustion chamber was re-designed and ducting was installed to re-circulate gases from the kiln exit fan to the inlet.

Before these adjustments were made fuel oil consumption was 6·25 gal. per ton of product. This was reduced to 4·4 gal. In December 1957 a second survey was made which showed that, by insulating the ducts and using preheated air, consumption could be further reduced to 3·8 gal. per ton of product.

Messrs. Robert Stephenson say the quality of the product has also improved so that an unexpected bonus has come from the improved fuel efficiency.

C.F. secretaries meet

Following in the wake of their enthusiastic fellow-secretaries who had recently made long journeys either to Knutsford or London, the local Chemists Federation secretaries of the South-western Region travelled well over 3,000 miles to Cheltenham on April 13, to meet, under the chairmanship of the Federation's president, Mr. F. E. Mellor to discuss problems of local organisation. It was an encouraging confirmation of the country-wide interest now being shown for C.F.

B.P.C. additions

The Pharmaceutical Society has approved the recommendation of the Codex Revision Committee that the preparations in the following list be included in the British Pharmaceutical Codex 1954, on September 1, 1958. The formulæ of the preparations and the requirements with which they comply are those in the British Pharmacopœia 1953 as amended by the 1955 Addendum.

Capsules of Carbon Tetrachloride
Emulsion of Chloroform
Emulsion of Cod-liver Oil
Emulsion of Peppermint
Liquid Extract of Belladonna
Dry Extract of Hamamelis
Dry Extract of Nux Vomica
Liquid Extract of Quillaia
Liquid Extract of Senna
Eye Ointment of Atropine with Mercuric Oxide
Eye Ointment of Penicillin
Concentrated Infusion of Quassia
Injection of Bismuth
Injection of Serum Gonadotrophin
Injection of Hydnocarpus Oil
Injection of Ethyl Esters of Hydnocarpus Oil
Injection of Mepacrine Methanesulphonate
Injection of Morphine and Atropine
Injection of Neoarsphenamine
Injection of Quinine and Urethane
Compound Injection of Sodium Chloride
Ammoniated Liniment of Camphor
Lozenges of Penicillin
Oleated Mercury
Ointment of Boric Acid
Strong Ointment of Mercuric Nitrate
Ointment of Mercury
Dilute Ointment of Mercury
Ointment of Penicillin
Aromatic Powder of Chalk
Aromatic Powder of Chalk with Opium
Compound Effervescent Powder
Compound Powder of Liquorice
Compound Powder of Rhubarb
Strong Solution of Ammonium Acetate
Arsenical Solution
Aromatic Spirit of Ammonia
Suppositories of Hamamelis
Syrup of Senna
Tablets of Acetylsalicylic Acid and Phenacetin
Tablets of Acetylsalicylic Acid with Ipecacuanha and Opium
Tablets of Barbitone
Tablets of Mercurous Chloride
Tablets of Phenacetin
Tablets of Sulphathiazole
Tincture of Digitalis

In the case of substances deleted from the British Pharmacopœia the statement in the monographs in the British Pharmaceutical Codex that these substances comply with the requirements of the British Pharmacopœia refers to the British Pharmacopœia 1953.

News from Abroad

WEST GERMANY

Cosmetic congress

The newly formed Gesellschaft Deutscher Kosmetik-Chemiker is holding a four-day congress in the University of Bonn from September 12 to 15. Seventeen papers are scheduled for presentation. Most will be given by German authors, but some will come from abroad. The Congress will be divided into four sections: chemistry of hair preparations, including dyes; chemical and biochemical aspects of aromatics and other raw materials; chemistry and biochemistry of emulsions; and fundamental research.

Applications to take part should be sent no later than June 15 to the Secretary of the Congress, Dr. F. Keil, Lappenbergsallee 9, Hamburg 19.

Chemical industry's good year

The German chemical industry had a good year in 1957 with turnover increasing by about 13·6% to an estimated total of DM.17.5 milliard as compared with DM.15.4 milliard the previous year. On the basis of turnover, chemicals form the third largest group in German industry after foodstuffs and machine building. The number of workers employed in the industry increased by approximately 22,000 to a total of 418,000 in the course of the year.

Prices during 1957 remained remarkably stable, and increased on average by less than 1%. Production is estimated to have expanded by approximately 11%, which is more than twice the average rate for German industry as a whole. The expansion is primarily attributed to the growth in the output of new products, especially plastics, and to the discovery of new uses for existing ones. The production of special chemical preparations, for example, increased by almost 13%.

About 26% of total production was exported in 1957. In the period January-October, chemical exports were 20% up as compared with the previous year, and for the year as a whole export turnover is estimated to have reached DM.4.5 milliard, or 15% more than 1956. By the end of the year, however, the rate of increase was beginning to fall away. As a percentage of total German exports, chemicals in 1957 still accounted for about 12·7%, whereas prewar it was as high as 17-18%. Exports to all foreign markets increased during the year with the exception of Australia. The traditional South American market, despite payment difficulties in certain cases, took German chemical products worth DM.235 million—an increase of 27% as compared with the previous year. Exports to the United States rose from DM.144 million to DM.183 million and as a result the United States became the third most important individual export market for German chemical products. Exports to Egypt also improved, mainly as a result of increased sales of nitrogenous fertilisers, and rose from DM.111 million in 1956 to DM.161 million.

Imports of chemicals and chemical products into Germany, on the other hand, increased in value from DM.1.34 milliard to DM.1.6 milliard. About 20% of total imports consisted of raw materials and the remainder of intermediates and finished products; imports of pharmaceuticals, for example, increased by more than 60%. The industry attribute the growth in imports to the Federal Government's liberal trade policies and to the reduction of customs duties.

CANADA

Commercial production of organophosphates

Production of organic phosphates has begun on a commercial scale at the Buckingham (Quebec) plant of Electric Reduction Co. of Canada Ltd., an Albright and Wilson company. The plant was recently considerably extended.

The present $500,000 annual Canadian market for organic phosphates has until now been supplied by exports from the United States and Europe.

Organophosphates are versatile products used in many industries for a wide range of applications. Uses for them vary—from plasticisers, stabilisers, anti-oxidants, catalysts, foam inhibitors, to insecticides and bactericides; they are also used in the extraction of heavy metals—an important Canadian use being in the solvent extraction of uranium.

BURMA

Pharmaceutical industry in production

The Burma Pharmaceutical Industry, a £5 million project for which a contract was secured in 1953 by Evans Medical Supplies Ltd., Liverpool, was officially opened by the President of Burma last month. Evans Medical undertook to provide a complete pharmaceutical industry designed to make the country virtually independent of foreign sources of supply. The industry is now producing, from broken rice, thousands of gallons of industrial and medicinal alcohol per month, and several million vitamin tablets. Sera and vaccines against smallpox, tetanus, gas-gangrene, typhoid, cholera, rabies and other diseases are being produced by the biological laboratories.

AUSTRALIA

Roussel plant planned

M. Jean-Claude Roussel, chairman of the Roussel Group, France, states that it is 90% certain that his company will establish a plant in Australia next year to make cortisone. "At present we import Australian ox-bile for the production of this drug," he says. "If a plant is established in Australia, a number of Australians will be trained in Paris in order that they may run the new plant."

Phthalic anhydride plant

A £1 million extension to the plant of the Newcastle Chemical Co. Pty. Ltd. at Newcastle, New South Wales, is under way to increase output of phthalic anhydride. At present this company makes most of Australia's needs of this chemical, but the continued growth of the paint and plastics industries requires much greater production.

Institute award

The Royal Australian Chemical Institute has awarded the Rennie Memorial Medal for 1957 to Dr. James Howard Bradbury of the Commonwealth Scientific and Industrial Research Organisation Wool Textile Research Laboratories.

New Vick factory

Vick Products (Pty.) Ltd., manufacturers of medical preparations, have opened a new factory in the Sydney suburb of Fairfield. Site is of 5 acres, and the new building covers about 33,000 sq. ft. The factory is completely air-conditioned.

Good investment

Financial experts here are agreed that the Australian chemical industry offers investors today one of their best prospects for growth, but, and here again there is agreement, the growth prospect seems to be with the large specialised chemical organisations. (A few years ago Taubmans sold its chemical division to Imperial Chemical Industries; then Timbrol merged with Union Carbide; now Drug Houses of Australia is to sell its Beetle-Elliott plastics business and its sulphuric acid plant to Monsanto Chemicals.)

Imports

Imports into Australia during the financial year ended June 30, 1957 (with values for the previous twelve months in parentheses), included: crude vegetable drugs, £113,259 (no

comparative figure); gums and resins, £1,504,044 (£1,667,609); tanning substances, £536,237 (£602,555); petroleum and shale oil products, £89,468,872 (£94,530,375); vegetable oils, £3,564,389 (£4,349,476); wood and wood tar oils, £163,494 (£161,451); petroleum jelly, £93,572 (£80,913); waxes, £780,193 (£733,779); other greases and fats, £437,478 (£434,868); and pigments, paints and varnishes, £6,516,499 (£5,936,633).

New explosive factory

I.C.I. of Australia and New Zealand Ltd. is to erect a £3 million factory at Bass Point, about 70 miles south of Sydney. This factory will manufacture commercial explosives, at present supplied solely from the company's works at Deer Park in Victoria. The new factory does not mean the end of activities in Victoria. "On the contrary," says managing director J. R. A. Glenn, "the trend in commercial explosives consumption is upward, as Australian development proceeds."

The company lifted its consolidated profit to a new peak of £2,495,316 in the year to September 30 last. Previous year's figure was £2,324,560. Sales reached a record £37,971,000. Fixed assets now total £19,723,000, with current assets at £23,500,000, including £14,400,000 stock. Ordinary dividend is steady at 9%.

HOLLAND

Dutch-American company formed

On March 5 a new company, Cyanamid-Ketjen N.V., was formed by American Cyanamid Co., New York, and Koninklijke Zwavelzuurfabrieken v/h Ketjen N.V., Amsterdam, both of them participating for equal parts in the capital of the new company.

The nominal registered capital amounts to D.Gld.40 million. The subscribed capital will shortly be paid up in full. The management of Cyanamid-Ketjen N.V. has been entrusted to Koninklijke Zwavelzuurfabrieken v/h Ketjen N.V. American Cyanamid Co. is represented in the board of directors by S. C. Moody, R. E. Lapean and G. W. Russell, and Koninklijke Zwavelzuurfabrieken v/h Ketjen N.V. by Ir. Th. S. G. J. M. van Schaik, D. de Jong and Ir. P. M. van Doormaal.

The first plant of this joint venture of A.C.C. and Ketjen is under construction on a site adjoining the Ketjen works. The first product to be made is a platinum catalyst for the oil industry.

The existing catalyst plants of Ketjen have partly been built with licences of A.C.C., whereas the latter now takes an active part in production in Holland. The establishment of the European Common Market was one of the reasons for this change in A.C.C.'s foreign policy.

DOMINICAN REPUBLIC

New factory

The Dominican Republic pharmaceutical firm, Laboratorio Quimico Dominicano, C. por A., has opened an additional factory in Ciudad Trujillo. Products to be produced include cream of magnesia and a variety of pills, tablets and pastilles. Ultraviolet lamps have been installed which, together with air-conditioning, will ensure an aseptic atmosphere.

Technical Press Review—May

Food Manufacture. — Rapid Techniques in Industrial Microbiology—2; Science and Sugar Confectionery; Mechanical Handling in Food Factories; Mechanical Handling Equipment.

Atomics. — Economics of Nuclear Ships; Ship Propulsion by Nuclear Power—1; O.M.R. and Ship Propulsion; C.C.G.C. Reactor for Ships; Tankers under the Sea; Neutron-induced Nuclear Reactions.

Paint Manufacture. — 12th ACHEMA Exhibition; Polyesters; Coatings of the Future; Paint in Other Languages; The Rose, Downs and Thompson Heating System; Analysis of Organotin Compounds.

World Crops. — Crop Protection and Pest Control Exhibition; Commercial Tomato Growing in the West Indies; Horticulture in the Himalayas; Seed Dressings; The Citrus Industry in Cyprus.

Petroleum. — Export Review of the Petroleum and Chemical Engineering Exhibition; Kent Refinery Expansion; Sulphuric Acid Alkylation; Hydraulic Tankers.

Automation Progress. — Automatic Handling and Treatment in Mining; A Driverless Truck for Works Transport; Fault Location and Control for Conveyor Systems; Reading Machines; Reducing the Queue; Mechanical Speed Variator in Automatic Clutch Systems; Electromagnetic Brakes and Clutches.

Dairy Engineering. — New Cleaning Technique for Centrifugal Plant; Electricity in the Dairy; Electrical Equipment for Dairies; Power Requirements in German Dairies; Production and Performance of Paraflow Pasteurising Plants; Current Progress in Cartoned Milk; Cheese Making in Czechoslovakia.

Chemical and Process Engineering. —Oils and Fats Processing; Estimation of Gaseous Densities; Costs of Mild Steel Drums; How Granules are formed; Preview of ACHEMA Exhibition.

NEW COMPANIES

These particulars of new companies have been extracted from the daily register of Jordan and Sons Ltd., company registration agents, Chancery Lane, London, W.C. 2.

Chemipoint Ltd. 28.2.58. Chemists, druggists, etc. £100. Subs.: Jean and Thos. A. Herbert, 156 Strand, London, W.C.2.

F. A. A. Jones Ltd. 28.2.58. 40 Commercial Road, Leeds 5. Chemists, etc. £4,000. Dirs.: Amy R. and Alexander M. Jones.

Merrell-National (Laboratories) Ltd. 3.3.58. 20 Savile Row, London, W.1. Manfrs. of and dlrs. in pharmaceutical remedies and preparations, etc. £50,000. Dirs.: Francis W. P. Corbould, David I. Wilson, Alan Talbot, Edward P. Anderson, John K. Lindsay and Sherwood E. Silliman.

Lavapine (Southern) Ltd. 18.2.58. 348/350 Greenford Avenue, Hanwell. Manfrs. of and dlrs. in wax polishes, etc. £1,000. Dirs.: Robert S. Morpeth, John Armstrong-Payne and George P. Peebles.

P. and J. Carr (Chemists) Ltd. 6.2.58. 125 Alwoodley Lane, Leeds 17. £2,000. Dirs.: Jack and Mrs. Phyllis Carr.

Rene de Londres Ltd. 7.2.58. 66 South Audley Street, London, W.1. Manfrs. of and dlrs. in perfumes, cosmetics, etc. £1,000. Dirs.: Rene and Mrs. Hugnette A. E. Moulard.

Hanger (Chemists) Ltd. 5.3.58. 5 Bowling Green Street, Leicester. £500. Dirs.: Neville R. and Mrs. Patricia M. Hanger.

J. Brian O'Dell Ltd. 5.3.58. Pharmacists, druggists, etc. £100. Dirs.: John B. and Mrs. Renee O'Dell, 59 London Road, Hailsham, Sussex.

F.A.I.R. Laboratories (Sales) Ltd. 5.3.58. To acquire part of the undertaking and assets of F.A.I.R. Laboratories Ltd.; to carry on bus. of chemists, manfrs. of and dlrs. in foodstuff and provision industries, and cosmetics, pharmaceutical and oil trades, mchts., bankers, shipowners and carriers. £20,000. Dirs.: Arnold E. M. Jansen, 59 Chepstow Place, London, W.2, Joseph De Vos and Henry A. Jansen.

J. Kennedy (Chemists) Ltd. 7.3.58. 14 Baylis Parade, Stoke Poges Lane, Slough. £3,000. Dirs.: James and Mrs. Kathleen Kennedy.

Swan's C.A.S.A. Ltd. 10.3.58. Corona House, The Common, Chorleywood, Herts. To acquire chemicals bus. relating to "Wetfix" hitherto cd. on at Crookhall Slag Works, Consett, Co. Durham, by Thomas Swan and Co. Ltd. and to carry on bus. of manfrs. of and dlrs. in chemicals and chemical compositions, including all cationic surface-active compounds used as oil solubles, emulsifiers, etc. £100. Dirs.: Thomas Swan and Alan P. Hughes.

Polybond Ltd. 27.3.58. 139 Tottenham Court Road, London, W.1. Manfrs. and dlrs. in chemicals, gases, drugs, medicines, etc. £100. Dir.: Harry Barron.

Lafan Chemicals Ltd. 28.3.58. Chemists, druggists, etc. £1,000. Subs.: Bryan T. Herbert, "Carisbrooke," Langley Avenue, Bingley, Yorks, and Norman W. Hopwood.

J. M. Turner (Chemists) Ltd. 19.3.58. 85 Agincourt Road, London, N.W.3. £500. Dirs.: Edith M. Turner, Christine R. Stein and Maurice A. Turner.

K. J. Monks (Pests) Ltd. 19.3.58. 5A Harpur Street, Bedford, animal and insect pest controllers, etc. £2,000. Dir.: Eric N. Foster.

Packaging

Half-oz. aerosol vials

Commenting on our note about aerosol containers in the March issue (p. 96), Econo-Mist Aerosol Developments, a division of the Rexall Drug Co., state that they are supplying stainless steel aerosol vials of ½ oz. capacity. They are similar to those in which the Riker *Medihaler* is packed. The same size of container in other metals is available.

★

Single tripper drum

The new taper-sided "T.S." drum, introduced by Reads of Liverpool, is made from light-gauge material and combines maximum strength and rigidity with exceptional lightness. With a diameter of 11 in. and height of 17 in., it has a capacity of 5 gal.

Three points to note about the "T.S." drum are:

(1) It is easily and firmly stacked, resulting in great space saving.
(2) Because it has a strong, straight side seam it is less liable to damage in transit.
(3) Costly return freight charges are unnecessary because of its low initial price.

The "T.S." drum is available in black steel or tinplate with side seams welded, when it is particularly suitable for liquid insecticides and other chemical products. It may also be supplied in tinplate with side seams re-tinned or soldered.

Both styles can be spray painted or lithographed to the customer's own design. The tinplate drum can, alternatively, be supplied unpainted.

There is a choice of standard neck fittings among which are the 50 mm. press cap. 50 mm. RingSeal, polythene FlexSpout closure, and the 3 in. seamless neck.

★

Polythene-lined gusseted bags

John Dickinson and Co. Ltd. have introduced their *Protecta* gusseted satchel for bulk capacity. It is made of bleached kraft, laminated to polythene. The centre seam is welded polythene to paper and the bottom is first welded and then turned up and gummed for double security. It is available in lengths between 5½ in. and 12¼ in., in face widths between 2½ in. and 8 in., and with a maximum face and gusset of 9 in. Food, fertiliser compounds and chemicals are some of the products for which these bags are said to be most suitable.

Heat sealable polythene-lined bags for bulk quantities.

New Products

Cheaper petroleum jellies

Since the war, supplies of petroleum jellies B.P. have been imported for the U.K. market almost entirely from U.S. producers.

N.V. Nederlandse Raffinaderij Van Petroleumproducten of Haarlem, Holland, are now marketing petroleum jellies (snow white, soft white and amber, all of B.P. specification) in this country for the first time, through Arthur Brown and Co. Ltd., London, who will be pleased to furnish readers with full details.

Hitherto, despite 50 years' experience in the manufacture of petroleum jellies, N.R.P. and other Continental refiners have been unable to match American qualities, particularly in consistency and length of fibre. Now owing to the availability of certain new raw materials, they are able to produce petroleum jellies up to American grades both in quality and specification.

The Dutch petroleum jellies are claimed to be completely free from odour and taste. They are, of course, available for sterling, and should save dollars, particularly as they are much cheaper than comparable products.

★

Hungarian anti-cancer drug

The Hungarian State Pharmaceutical Consortium have nominated Leda Chemicals Ltd. (Pharmaceutical Division), a subsidiary of F. W. Berk and Co. Ltd., as sole distributors in the U.K. and most Commonwealth countries for their new anti-neoplastic drug *Degranol*, known formerly to research workers in the chemotherapy of cancer as B.C.M.

This product was first prepared by Dr. L. Vargha of Hungary by linking nitrogen mustard with mannitol to form 1.6-bis-(beta-chloroethylamino)-1.6 - desoxy - D - mannitol - dihydrochloride.

It is claimed that extensive clinical trials in Hungary have shown *Degranol* to be a powerful yet virtually non-toxic inhibitor of neoplastic growths. Particularly favourable results have been obtained in the treatment of malignant diseases of hæmopoietic and lymphatic systems. Large-scale controlled clinical trials are now being carried out in this country.

Degranol is being exhibited by Prof. Kellner at the forthcoming Cancer Congress in London.

★

Amorphous silica

Joseph Crosfield and Sons Ltd. have acquired the trade name *Neosyl* from Peter Spence and Sons Ltd., and are now manufacturing and marketing a comparable product under that name.

Neosyl is a fine white powder of exceptionally small ultimate particle size (about 0·10 micron), and is a pure form of amorphous silica. It can be used as a mild abrasive in polishes; a carrier and dispersing agent for insecticides; a pesticide; an ingredient in toothpastes, etc.

★

Disinfector

The Spa-Flo Co. have introduced the *Spa-Gene* sink trap disinfector, a plastic bulb containing disinfectant which is easily screwed on to sink traps. It retails at 3s. 6d.

THE CHEMICAL MARKET

MORE REDUCTIONS

LONDON.—A substantial reduction in the price of **aluminium stearate** brings it to £253 10s. per ton. **Iodides,** potassium B.P. and sodium B.P. are cheaper by a few pence. **Iodides,** ethyl, are now available in 3½ kg. bottles and 20-litre drums. **Tannic acid** is 1s. lb. dearer. **Ferrous gluconate** has been added to our list and **calcium gluconate** is given in lb. quantities. Gums and waxes continue their downward trend, especially in most grades of **tragacanth, shellac** and **carnauba.** An exception is **beeswax,** Sudan spot being £2 10s. cwt. dearer.

FINE CHEMICALS

Acetanilide
12½ kg. 7s. 2d. kg.
Arsenious oxide B.P.
7-lb. lots 1s. 9d. lb.
1 cwt. lots 1s. 2d. lb.
Ascorbic acid
100 kg. £4 14s. kg.
Aspirin
56 lb. 5s. 2d. lb.
1-cwt. 4s. 11d. ,,
5-cwt. lots 4s. 9d. ,,
Atropine
Sulphate, 500 g. & over £51 2s. kg.
Alkaloid, 500 g. £59 18s. kg.
Benzene B.P.C. 28-lb. lots 1s. 8d. lb.
Benzoic acid 12½ kg. 7s. 4d. kg.
Benzyl benzoate
According to pack 5s. to 5s. 6d. lb.
Bismuth oxide B.P.C. 1934
28-lb. lots 26s. 10d. lb.
Bismuth salts 28-lb. lots:
Carbonate 22s. 3d. lb.
Subgallate 21s. 1d. ,,
Salicylate 21s. 9d. ,,
Subnitrate 20s. 5d. ,,
Borax B.P.
Powder (hessian bags) £58 10s.
,, (paper bags) £57 10s.
Extra fine (hessian bags) £59 10s.
,, ,, (paper bags) £58 10s.
Boric acid B.P.
Crystal (hessian bags) £96 10s.
,, (paper bags) £95 10s.
Powder (hessian bags) £94
,, (paper bags) £93
Bromine B.P.C.
7-lb. lots 6s. lb.
Caffeine 50 kg. 42s. kg.
Calamine 50 kg. 4s. kg.
Calcium gluconate
1 cwt. lots dlvd. 3s. 7d. lb.
Calcium glycerophosphate
50 kg. 22s. kg.
Calcium lactate B.P.
7-lb. lots 3s. 6d. lb.
1-cwt. lots 2s. 11d. ,,
Chloral hydrate 50 kg. 10s. kg.
Citric acid, B.P.
Powder or granulated:
1-cwt. lots £11 5s. cwt.
5-cwt. lots £11 ,,
Codeine
Alkaloid 100 g. £103 3s. kg.
Phosphate 100 g. £110 ,,
Ephedrine 500 g. lots
Hydrochloride 3 kg. £6 12s. 3d. kg.
Alkaloid 3 kg. £12 7s. kg.
Sulphate 3 kg. £6 12s. 3d. ,,
Eucalyptol
1-cwt. lots 12s. 6d. lb.
5-cwt. lots 12s. ,,
Ferri ammonium citrate B.P.
1-cwt. lots, scales 4s. 8d. lb.
1-cwt. lots, granules 3s. 11d. ,,
Ferrous gluconate
1 cwt. lots dlvd. 6s. 3d. lb.
Gallic acid B.P.C.
1-cwt. lots 9s. 8d. ,,
Glycerophosphoric acid
24 litres 11s. 10d. litre
Glycine (amino acetic acid)
12½ kg. 22s. 4d. kg.
Hexyl resorcinol 10 kg. £7 15s. kg.
Hydroquinone 12½ kg. 22s. 6d. kg.
Iodides
Ethyl
3½ kg. bottle 54s. 3d. kg.
20-litre drum 115s. litre
Mercury, red B.P.C.
28-lb. lots 27s. lb.
1-cwt. lots 26s. ,,
Potassium B.P.
28-lb. lots 8s. 6d. ,,
1-cwt. lots 8s. 3d. ,,
Sodium B.P.
28-lb. lots 13s. ,,
1-cwt. lots 12s. 9d. ,,
Iodine, Chilean crude, 99% min. in wooden casks 15s. kg.
Iodoform
12½ kg. and under 50 kg. 44s. 6d. kg.
Lactose 50 kg. 3s. 4d. kg.
Lithium salts 5-cwt. lots
Benzoate 10s. lb.
Carbonate B.P.C. 11s. 3d. ,,
Chloride (commercial) powder 11s. ,,
,, granular 10s. 9d. ,,
Hydroxide 9s. 9d. ,,
Citrate B.P.C. 9s. ,,
Sulphate 8s. 6d. ,,
Salicylate, 10 cwt., dlvd. 9s. 9d. ,,
Magnesium carbonate B.P.
Light cwt. lots dlvd. £129 ton
Magnesium trisilicate
28-lb. packages
28-lb. lots 4s. 3d. lb.
1-cwt. lots 3s. 10d. ,,
5-cwt. lots 3s. 7d. ,,
Bulk rates for larger quantities are from 3s. 1d. lb. in 1 ton lots
Manganese hypophosphite B.P.C.
7-lb. lots 13s. 11d. lb.
1-cwt. lots 12s. 11d. ,,
Mercuric chloride B.P.
50-kg. lump 48s. 6d. kg.
Methyl salicylate 1-cwt. lots 3s. 3d. lb.
Morphine
Alkaloid, 100 g. £106 14s. kg.
Nicotinamide 1 kg. £4 10s. kg.
Nicotinic acid
12½ kg. 52s. 6d. kg.
1 kg. 55s. ,,
Oleine, B.P. extra pale, 3/4 cwt. drums returnable carriage paid G.B. £165 ton
Phenolphthalein 50 kg. 24s. 3d. kg.
Phosphoric acid B.P.
(s.g. 1·750) 10 carboy lots 1s. 4d. lb.
Potassium permanganate B.P.
1-cwt. lots dlvd. 1s. 11¼d. lb.
Procaine hydrochloride (foreign) 2 kg. 59s. 6d. kg.
Quinine 1 oz. lots 4s. 4d. oz.
Riboflavin
100 g. 5½d. g.
10 g. 7d. ,,
Saccharin
500 g. £7 4s. for this quantity
Salicylic acid
B.P., dlvd. 3s. 2½d. to 5s. 6d. lb.
Silver nitrate
500 g. 4s. 2 5/16d. oz.
Sodium benzoate B.P.
1-cwt. lots 2s. 9½d. lb.
1-ton lots 2s. 7½d. ,,
Sodium salicylate
50 kg. 8s. 8d. kg.
12½ kg. 9s. ,,
Sodium thiosulphate
Crystals, photographic quality
1-ton lots 49s. cwt.
Stearic acid B.P.C. flake, carriage paid G.B. £154 ton
Strychnine 25 oz.
Alkaloid 5s. 10d.
Hydrochloride 4s. 11d.
Sulphate 4s. 11d.
Sulphaguanidine
12½ kg. 33s. kg.
50 kg. 32s. ,,
Sulphanilamide
12½ kg. 16s. 6d. kg.
50 kg. 15s. 4d. ,,
Sulphathiazole 12½ kg. 39s. 1½d. kg.
Tannic acid B.P. Levis
1-cwt. lots 10s. lb.
Tartaric acid B.P.
Powder or granulated,
10 cwt. or more £14 cwt.
Terpineol, B.P.
40-gal. drums 2s. 5d. lb.
1-cwt. lots 2s. 8d. ,,
Theophylline, B.P.
500 g. 27s. 6d. for this quantity
Thiamine hydrochloride
100 g. 4½d. g.
1 kg. £14 2s. 6d. kg.
Thioglycollate
Ammonium 12s. 4d. to 16s. 4d. lb.
Calcium:
7-lb. lots 17s. 3d. ,,
5-cwt. lots 14s. 3d. ,,
α-Tocopherol 10-g. lots 1s. 2d. g.
Vanillin 26s. to 30s. 6d. lb.
Zinc oxide, B.P.
2-ton lots £127 ton

GENERAL CHEMICALS

Acetic acid 1-ton lots dlvd.
80% Technical £99 ton
80% Pure £105 ,,
Glacial B.P. £114 ,,
99-100% Glacial £111 ,,
98-100% Glacial £108 ,,

Acetic anhydride
1-ton lots dlvd. £143 ton
Acetone
5-gal. drums, free, non-returnable £128 ton
40 to 45-gal. drums, 10-ton lots £88 ,,
Alum, potassium granular crystals
50 kg. 1s. 2d. kg.
Aluminium hydroxide B.P.C. 34
28-lb. lots 2s. 4d. lb.
Aluminium stearate
(Precipitate) 1-ton lots £253 10s. ton
Ammonia
Persulphate £6 2s. 6d. cwt.
Phosphate: Mono- £106 ton
Di- £100 ,,
Amyl acetate
B.S.S. 10 tons and over £251 ton
Technical £249 ,,
Amyl alcohol
Technical in 1-ton lots £260 ton
Arsenic White powdered ex store £37-£38 ton
***n*-Butyl acetate**
10-ton lots £173 ton
***n*-Butyl alcohol**
10-ton lots £152 ton
Calcium chloride
Solid 70 to 72%, 4-ton lots dlvd. £15 17s. 6d. ton
Calcium oxide (Lime)
Ex marble 28-lb. lots 3s. 10d. lb.
Caustic soda
Solid 1-ton lots, from £32 9s. to £34 4s. ton
Chloroform B.P. ½-ton lots 3s. 1½d. lb.
Chromic acid
Dlvd. U.K. (less 2½%) 2s. 0¼d. to 2s. 0¾d. lb.
DDT 3s. 0½d. to 3s. 2d. lb.
2 : 4-Dichlorophenoxyacetic acid
99% pure, 1-cwt. bags £340 ton
Dimethyl sulphate 400 lb. drum lots 1s. 8d. lb.
Ether (Di ethyl ether)
Tech. B.S.S. and Solvent B.P. 1-ton lots in drums 2s. lb.
Ethyl acetate 10-ton lots £145 ton
Ethyl alcohol
95% Gay Lussac 66·0 o.p.
2,500 to over 300,000 proof gallons per year in tank wagons 4s. 2¾d. to 4s. 0¼d. per proof gal.
Ferrous sulphate 50 kg. 1s. 4d. kg.
Formaldehyde
40% by volume dlvd. England 1-ton lots £38 15s. ton
Glycerin
1,260 s.g. chem. pure, 5 tons and up, 5-cwt. drums £201 10s. ton
1,260 s.g. refined pale straw, indus., 5 tons and up, 5-cwt. drums £196 10s. ton
Hexamine
1-ton lots
Technical, bulk 1s. 8d. lb.
B.P.C. 1s. 11d. ,,
Hydrochloric acid
Commercial 18s. 6d. cwt.
Hydrogen peroxide
27·5% weight £128 10s. ton
35% weight £158 ,,
Lactic acid (1-ton lots)
Pale tech. 44% by weight 1s. 3¼d. lb.
Dark tech. 44% by weight 9¼d. lb.
Magnesium chloride
Solid (ex wharf): 1-ton lots £17 10s. ton
Magnesium sulphate £14 10s. to £15 5s. ton
Mercurous chloride (calomel)
50 kg. 62s. 3d. kg.
Mercury sulphide, red
Ton lots and over 30s. 6d. lb.
Methylated spirits (Industrial)
Perfumery quality 500 gal. and upwards:
61 o.p. 7s. 4d.
74 o.p. 7s. 11½d.
5 to 10 gal.:
61 o.p. 8s. 8d.
74 o.p. 9s. 3½d.
Methyl ethyl ketone
10 tons dlvd. in drums £143 ton
Methyl isobutyl carbinol
10 tons and up, in drums, dlvd. £163 ton
Methyl isobutyl ketone
10 to 50 tons, in drums, dlvd. £169 ton
Naphthalene
Crystal, dlvd., 4-ton lots, spot £65 4s. 3d. ton
Ball and flake (ditto) £73 14s. 5d. ,,
Nickel sulphate
dlvd. ton lots £200 ton
Nitric acid 70% intermediate £32 ,,
Pentachlorphenol
Flake, technical, 1-ton lots, dlvd. 2s. 2d. lb.
Phenol Crystals:
Under 1 ton dlvd. from 1s. 7d. lb.
10 tons and over dlvd. in returnable drums from 1s. 4½d. lb.
Phthalates
10 ton lots in drums
Diethyl £187 10s. ton
Dimethyl £179 ton
Potassium bromide
50 kg. 5s. 6d. kg.
12½ kg. 5s. 8d. ,,
Potassium carbonate
Calcined 96 to 98% (1-ton lots ex store) £76 ton
Hydrated (1-ton lots) £74 10s. ,,
Potassium fluoride
28-lb. lots 5s. 1d. lb.
Potassium sodium tartrate
5-cwt. lots £10 cwt.
Soda ash
1-ton lots dlvd., from £13 19s. 6d. to £16 15s. 6d. ton
Sodium cyanide
96-98% £128 ton
Sodium hydroxide 28 lb. lots:
sticks (1 lb. bottles) 4s. 3d. lb.
pellets ,, ,, 3s. 9d. ,,
Sodium metal 28-lb. lots 3s. 8d. ,,
Sodium metasilicate
Dlvd. U.K. in ton lots £26 ton
Sodium phosphate
Dlvd. ton lots: Di-sodium, crystalline £40 10s. ton
Anhydrous £88 ,,
Tri-sodium, crystalline £39 ,,
Anhydrous £86 ,,
Sodium silicate
according to quantity, grade and delivery point
4 ton lots £13 10s. ton
1 ton lots £15 ,,
Sodium sulphate Ex works:
(Glauber salt) £13 ton
(Salt cake) unground, full truck loads £8 16s. 6d. ton
Sodium sulphide
Broken, returnable drums, dlvd. ton lots £37 2s. 6d. ton
Flake, ditto £38 12s. 6d. ,,
Solid ditto £36 2s. 6d. ,,
Sodium sulphite
Commercial crystals 4-ton lots £24 10s. ,,
(Dlvd. London in 1-cwt. single non-returnable bags)
Sodium tripolyphosphate
1-ton lots £95 ton
Stannic chloride 28-lb. lots 8s. 11d. lb.
Stannous chloride 28-lb. lots 9s. 5d. lb.
Strontium carbonate
96-98% 28-lb. lots 3s. lb.
Sulphuric acid, ex-works, according to quality and quantity
B.O.V. 78% from 8s. to 10s. cwt.
C.O.V. 96% from 11s. to 14s. cwt.
Zinc chloride
28-lb. lots sticks 6s. 9d. lb.

OILS AND FATS

Palm kernel oil
Refined, deodorised, 2-ton lots, naked, ex works £118 ton
Palm oil
Refined, deodorised, 2-ton lots, naked, ex works £108 ton
Stearine
Flake triple-dressed, dlvd. (bags free and non-returnable) carriage paid G.B. £149 ton

GUMS AND WAXES

Agar Agar No. 1
Kobe strip 12s. 3d. lb.
Powder 17s. 6d. ,,
Beeswax
Dar-es-Salaam spot (nominal) £29 cwt.
Sudan spot £28 10s. ,,
Bleached white (slab) £30 ,,
Refined yellow (slab) £29 ,,
Benzoin
Sumatra spot £28 cwt.
Siam spot (nominal) £2 7s. 6d. lb.
Candelilla Spot £24 cwt.
Carnauba
Prime, Spot £52 cwt.
Fatty grey £29 10s. ,,
Gum arabic
Lump £7 10s. cwt.
Karaya
Powder, Spot 3s. 6d. lb.
Paraffin wax
1-ton lots, acc. to grade £87 10s. to £120 ton
Peru balsam 11s. 9d. lb.
Shellac
No. 1 orange £14 cwt.
No. 2 orange £12 ,,
Transparent white 4s. 6d. lb.
Pale dewaxed 6s. ,,
Tragacanth
No. 1 spot £151 cwt.
No. 2 spot £142 ,,
Pale leaf £54 ,,
Amber £41 ,,
Brown to Red £30 ,,

NEW TRADE MARKS

APPLICATIONS

Cosmetics and toilet preparations

PATRA.—766,690. *Gebrüder Kleiner.*

MON AFFAIRE.—772,759. *Saville Perfumery Ltd.*

ALPHA.—756,781. *Alpha Pharmaceuticals Ltd.*

MORGAN'S.—763,038. *Morgan's Pomade Co. Ltd.*

FRAIGEL. — 767,109. *Consortium Méditerraneen de Parfumerie.*

CUSSONS BEAUTY BAR. — 771,638.

CUSSONS CHARM.—771,705. *Cussons Sons and Co. Ltd.*

FRISCURA. — 772,344. TOSCA-TOSCANI.—771,298. *Eau de Cologne and Parfümerie Fabrik Glockengasse No.* 4711.

HIGH TIME.—772,726. *Erasmic Co. Ltd.*

COTY LA FAVORITA.—767,586. *Coty (England) Ltd.*

CREME MOUSSELINE. — 770,028. *Guerlain Ltd.*

BLUE PEARL.—771,117. *Crosfields (CWG) Ltd.*

CAPTIVE BEAUTY.—771,216. *Yardley and Co. Ltd.*

SHOCK.—771,084. *Gala of London Ltd.*

Pharmaceuticals

BIOCITIN.—754,993. *Biocitin-Fabrik Ulrich Patz.*

SPANTABS.—768,506. Clinical Products Ltd.

PHENAPHEN. — 770,653. *A. H. Robins Co. Inc.*

EDIKORT.—770,743. *Parke Davis and Co.*

FENISTIL.—770,827. *Ciba Ltd.*

SPASTIONEX.—771,449. BRONCHIONEX.—771,450. ASPRIONEX.—771,451. *Clinical Products Ltd.*

REDOXON QUIKSOLV. — 771,960. *Roche Products Ltd.*

EF - DELTELAN. — 772,098. EF-DELCORLIN. — 772,477. DELCORLIN. —772,478. *Glaxo Laboratories Ltd.*

VITOCEE.—772,324. *Boots Pure Drug Co. Ltd.*

MEZURAN.—772,980. *Imperial Chemical Industries Ltd.*

TELMID.—773,099. *Eli Lilly and Co.*

LUCINAL. — 770,696. *Wellcome Foundation Ltd.*

ELEVEN-PLUS. — 770,759. 11-PLUS. —770,760. *United Chemists Association Ltd.*

HISTRYL.—771,709. *Smith Kline and French Laboratories Ltd.*

TUDAPIN.—772,037. *Farbenfabriken Bayer A.G.*

GLUKEFF.—772,173. *Boots Pure Drug Co. Ltd.*

MORGAN'S.—772,465. *Morgan's Pomade Co. Ltd.*

ACTRIOL.—772,631. RAUBALGINE. —772,632. *Organon Laboratories Ltd.*

FLOROTIC.—772,705. *E. R. Squibb and Sons Ltd.*

QUATORAL.—767,658. *Thos. Guest and Co. Ltd.*

CARMERIN.—767,664. *H. R. Napp Ltd.*

PERLONGIT.—767,668. *C. H. Boehringer Sohn.*

PERIVAR.—767,679; BAGROSIN.—767,678. *Curta and Co. G.m.b.H.*

SOLZETS.—767,870. *Boots Pure Drug Co. Ltd.*

GENACORT.—767,941. *Genatosan Ltd.*

ORTHO.—762,662. *Ortho Pharmaceutical Corporation.*

BRONTYL.—766,073. *Siegfried A.G.*

ALBIOTIC.—766,268. *Upjohn of England Ltd.*

VIRIBA.—767,032. *Modern Health Products Ltd.*

SEBBAN.—767,201. *Genatosan Ltd.*

TERMINEX.—767,608. *Trevena Ltd.*

LUSTY'S KALMS.—768,102. *Lusty's National Products Co.*

PENITRIAD.—768,270. *May and Baker Ltd.*

ISODORM.—768,691. *Clinical Products Ltd.*

AVERTILAN.—768,805. *British Drug Houses Ltd.*

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NEW PATENTS

COMPLETE SPECIFICATIONS ACCEPTED

Antibiotics

Recovery of tetracycline from fermentation broths. *Bristol Laboratories Ltd.* 794,738.

Streptomycin salts and process for their preparation. *Koninklijke Nederlandsche Gist-En Spiritusfabrik N.V.* 795,757.

Recovery of griseofulvin from a fermentation broth and compositions containing them. *Glaxo Laboratories Ltd.* 795,039.

Antibiotic vancomycin and its production by fermentation. *Lilly and Co. Ltd.* 795,289.

Penicillin salts. *Imperial Chemical Industries Ltd.* 795,934.

Salts of novobiocin. *Soc. des Usines Chimiques Rhône-Poulenc.* 795,856.

Amphotericins, their salts and method of manufacture. *Olin Mathieson Chemical Corp.* 795,482.

Soaps, detergents, etc.

Stabilised soap compositions. *Unilever Ltd.* 795,674.

Bactericidal detergent compositions. *Imperial Chemical Industries Ltd.* 795,814.

Cleansing compositions. *Reckitt and Colman Ltd.* and *R. S. Howard.* 795,618.

Detergent compositions for the hair. *Ciba Ltd.* 793,786.

Manufacture of soap. *Unilever Ltd.* 794,428.

Fertilisers

Fertilisers. *E. T. L. Schioler.* 795,805.

Mixed fertilisers. *Suddeutsche Kalkstickstoffwerke A.G.* 795,767.

Fertilisers. *Fisons Ltd.* 795,781.

Pharmaceuticals

β-kainic acid, its isomers and their derivatives and a method for preparing their inverted compounds. *Takeda Pharmaceutical Industries Ltd.* 795,750.

Pharmaceutical compositions. *Imperial Chemical Industries Ltd.* 795,750.

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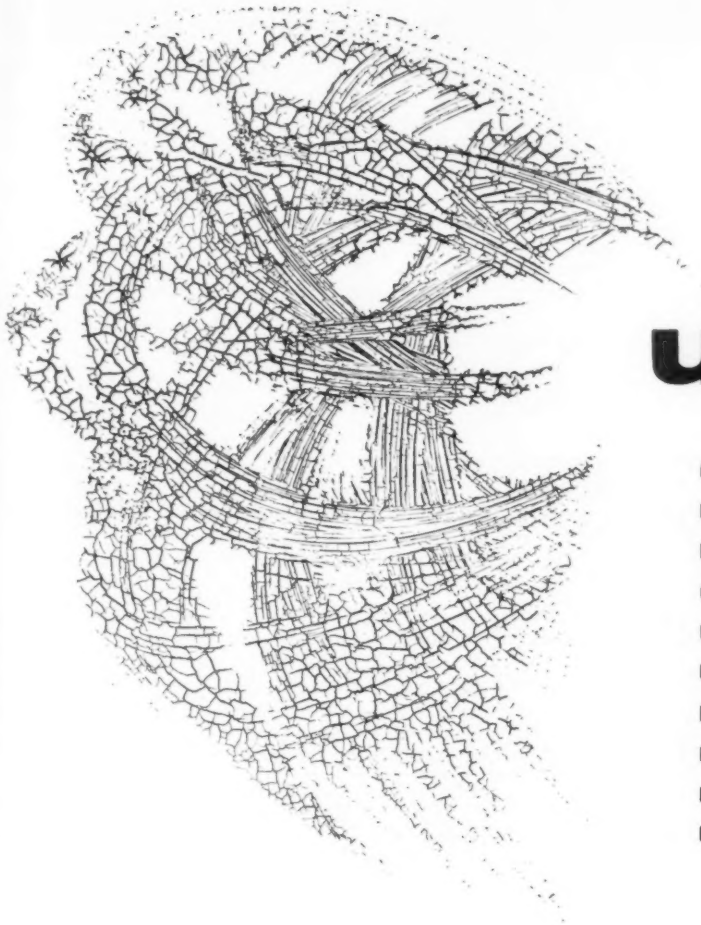
From MANUFACTURING CHEMIST, May 1898

The chemistry of ice creams

Our enterprising evening contemporary, *The Star*, has been making an energetic and persistent crusade against the peripatetic ice cream vendor and the wares he sells, affirming—and we doubt not that it is the truth—that in addition to certain chemical introductions, which frequently render it absolutely poisonous, the inhabitants of the filthy Italian quarter in which this so-called cream is manufactured are not at all above mixing up with it, in the process of manipulation, " any of the bugs, fleas, human hair, animal hair, or other dirt and refuse with which at the moment they may be surrounded."



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The 'H' Stainless Steel Mixer.
Transparent plastic lid.
Safety guard. Tilts to empty.
Removable paddle.

SPECIFICATION

Capacity	100 lb. of powder
Height	3' 6"
Floor Space ..	5' 7" × 2' 6"
Horse Power of motor ..	2
Speed of motor	1,430 r.p.m.
Weight	969 lb.

The MANESTY 'H' Stainless Steel Mixer has been designed for the intimate mixing of powders or moist masses and is especially suitable for tablet granulation.
The powerful geared drive and sturdy paddle make the MANESTY 'H' Mixer ideal for dealing with difficult or sticky ingredients.

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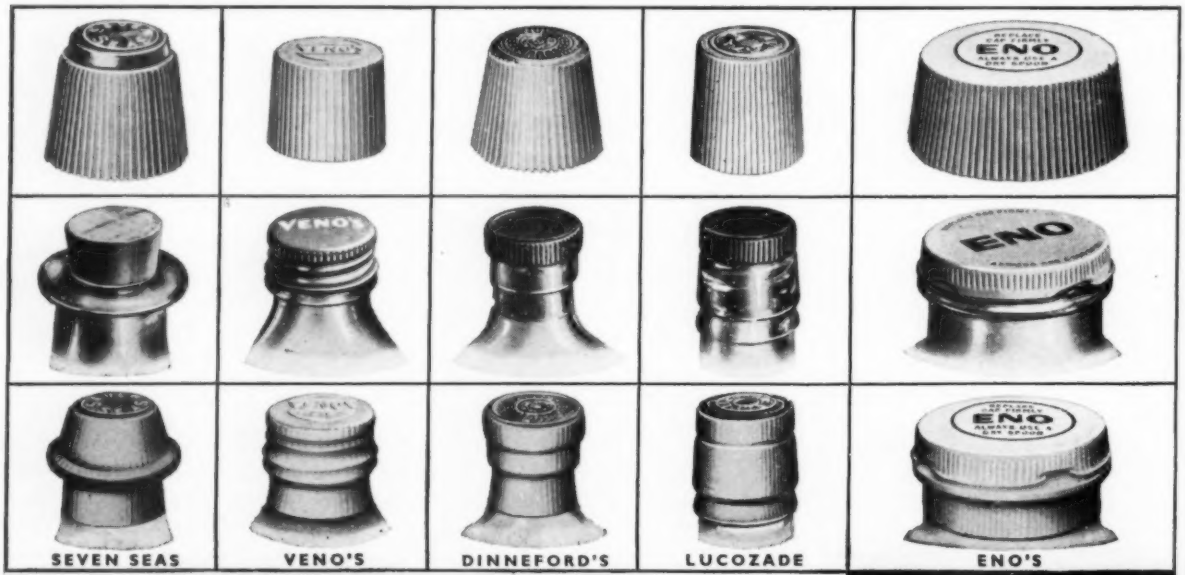

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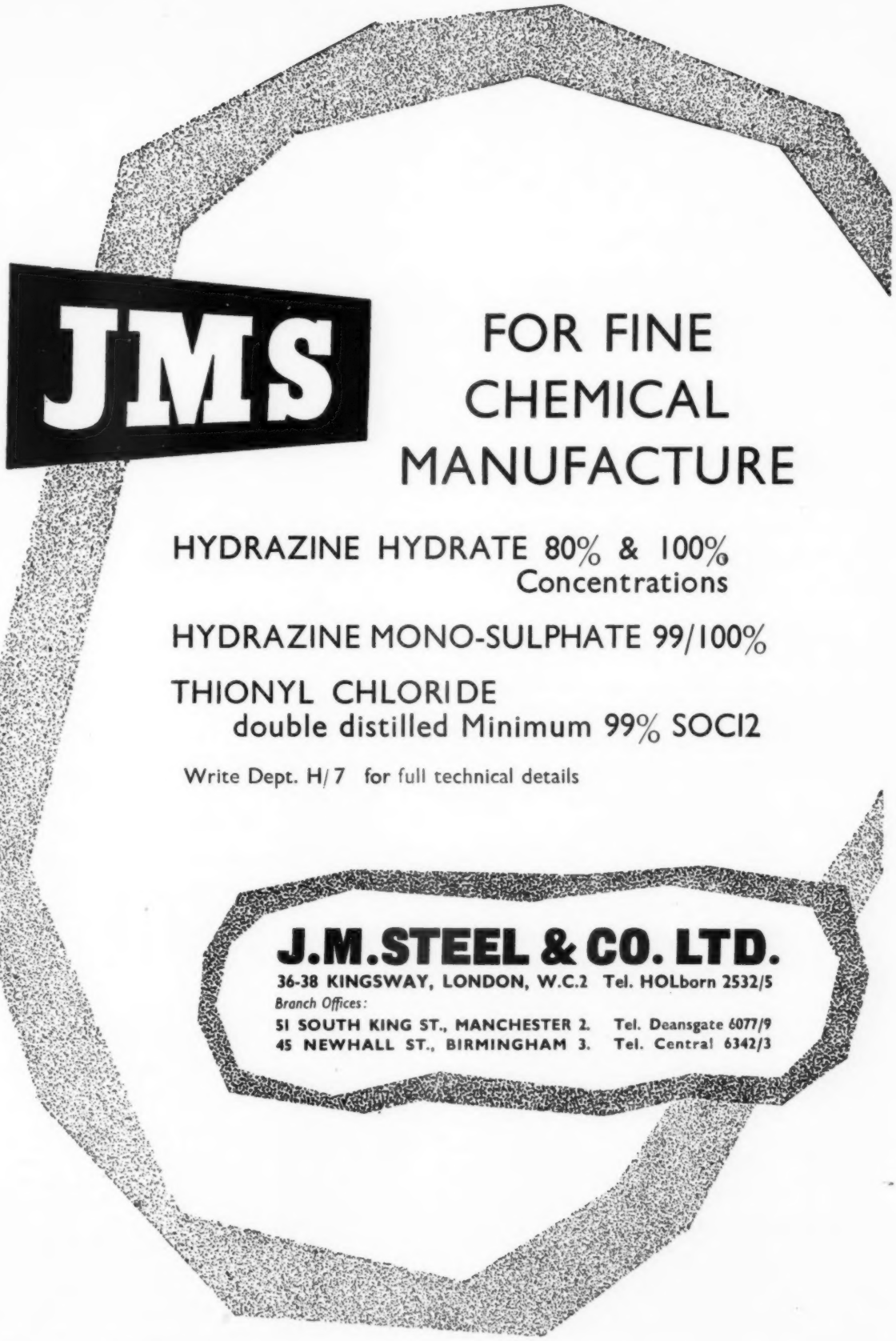
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To all who are interested in Iodine—its effects, its uses, its possibilities—the Chilean Iodine Educational Bureau offers information and advice. Reviews of selected aspects of Iodine usage are available on request. Every endeavour will be made to satisfy your enquiries.

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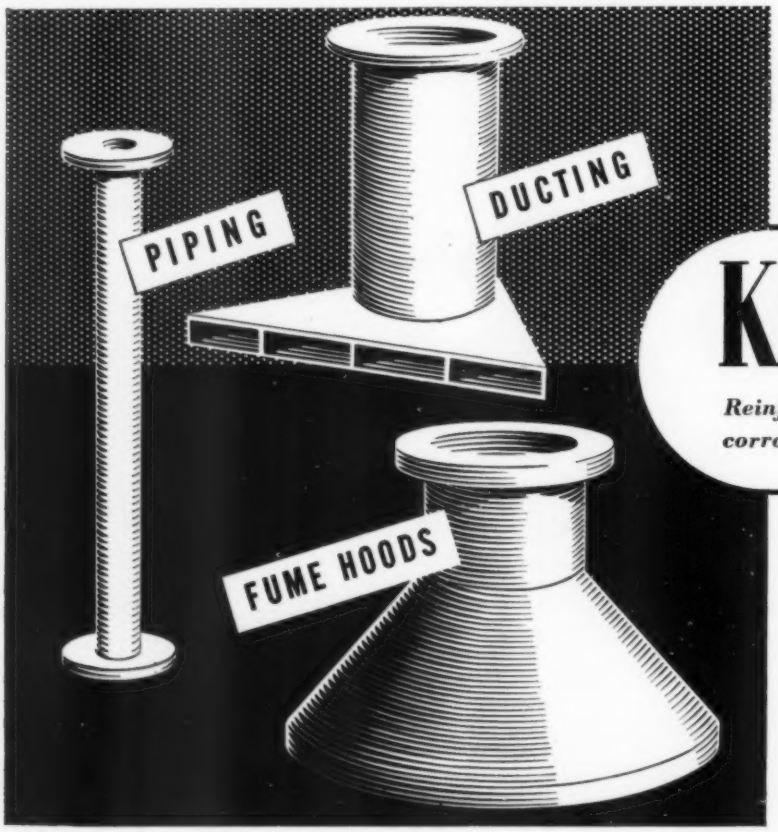

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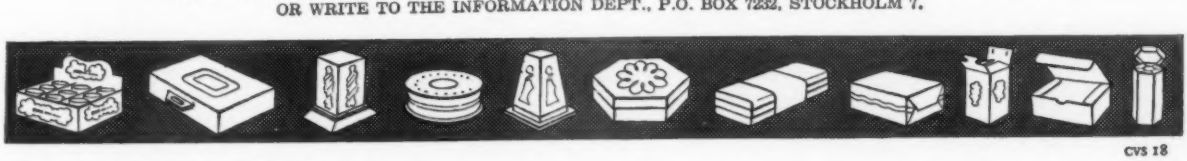

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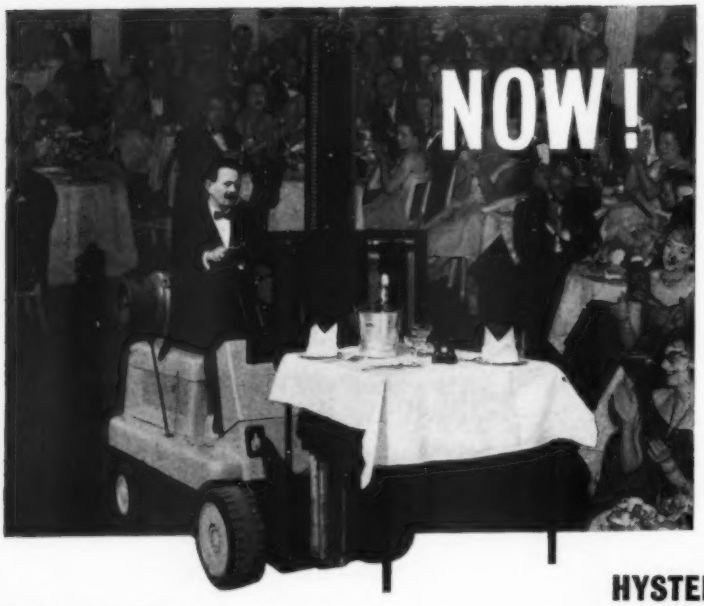

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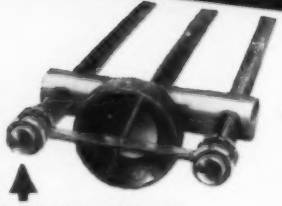

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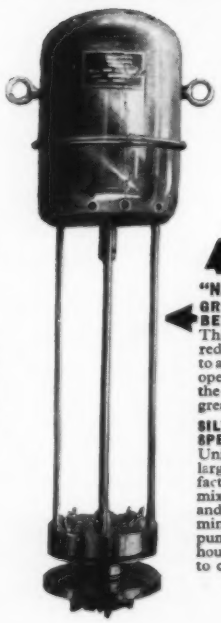

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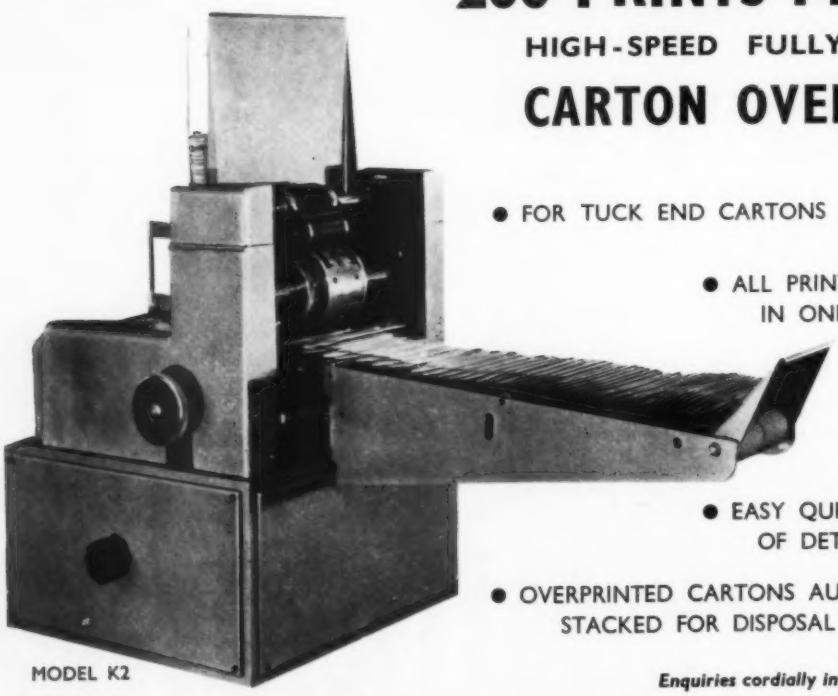
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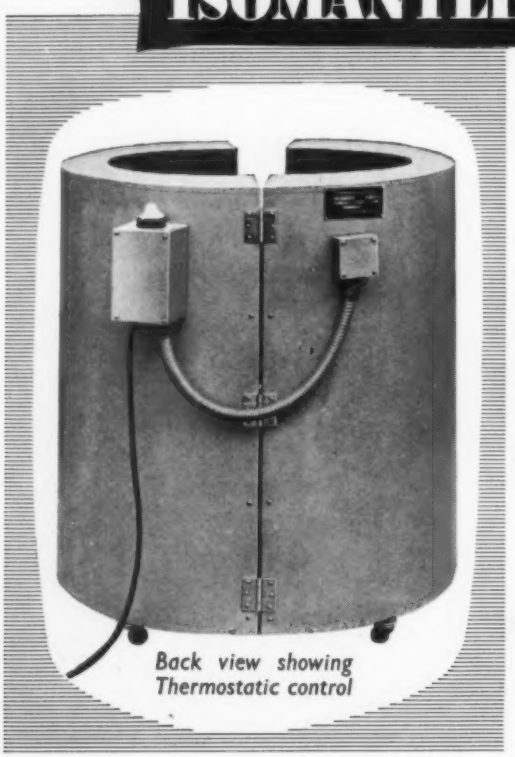

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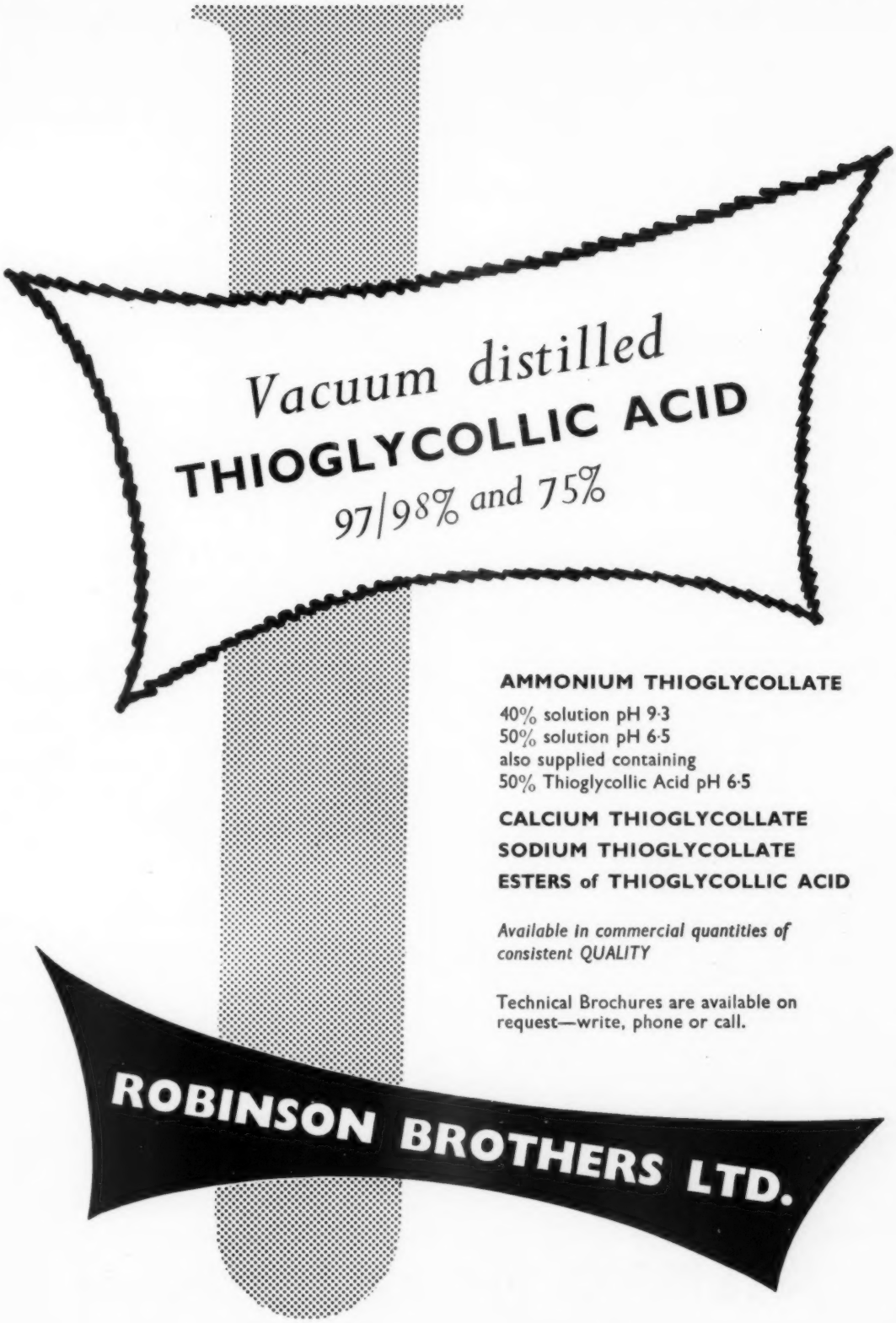

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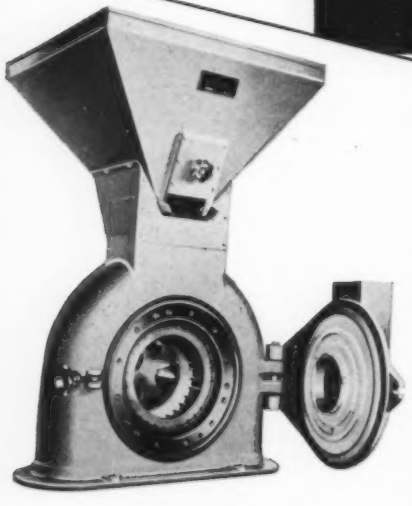

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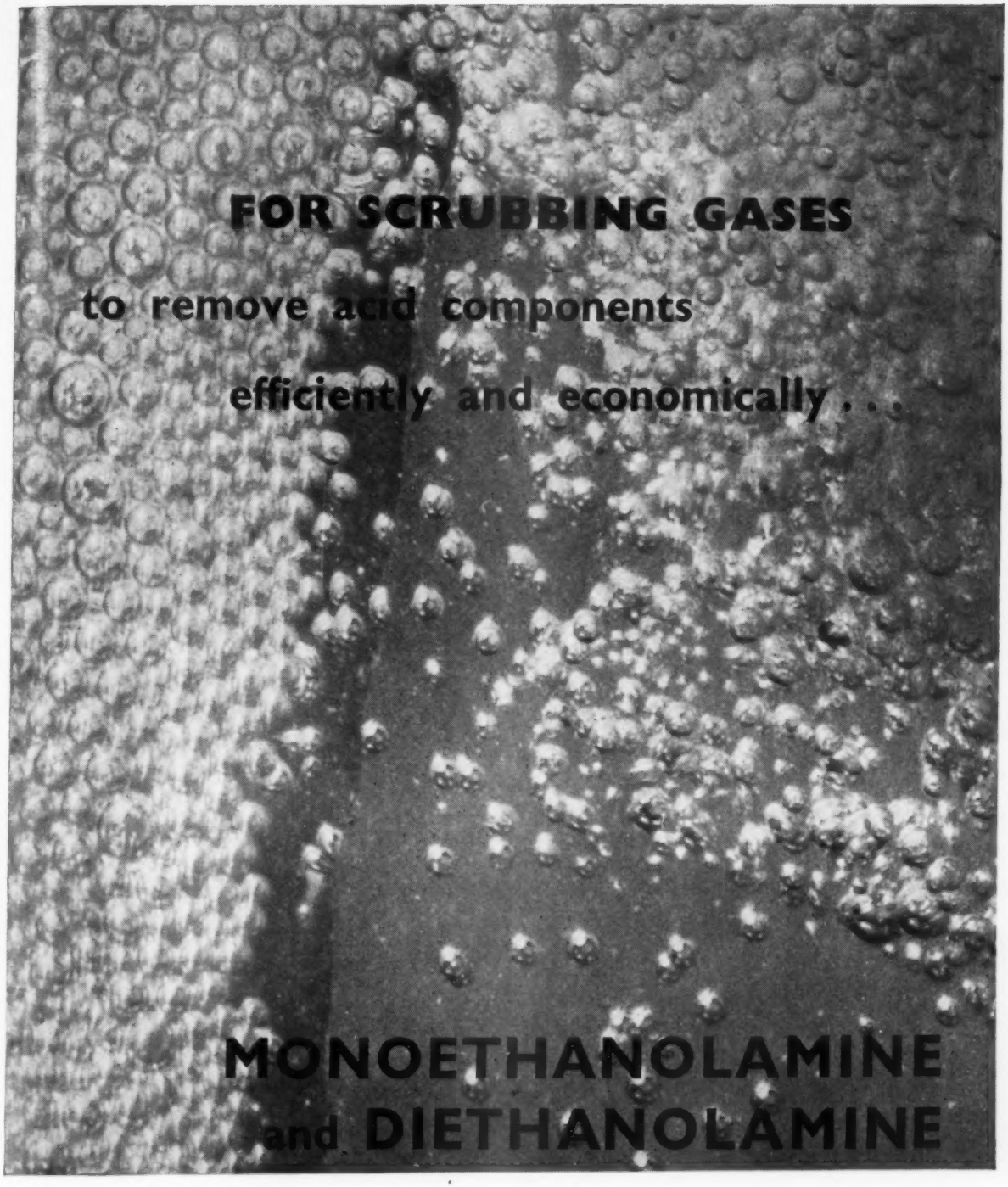

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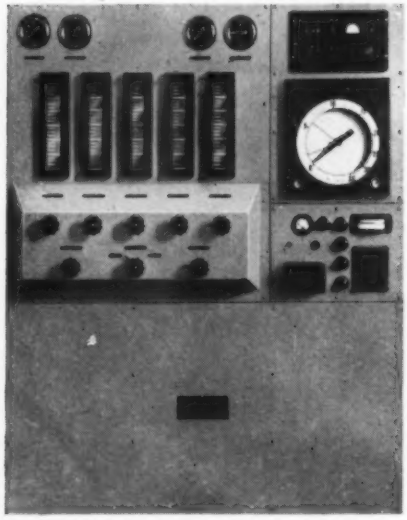

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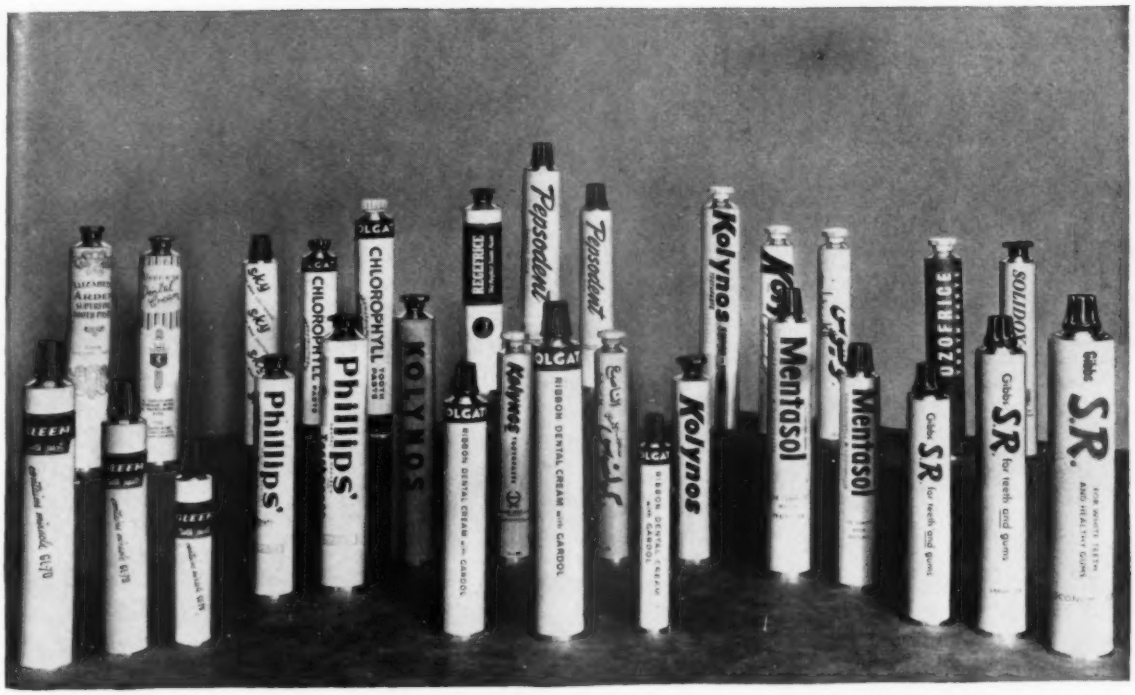

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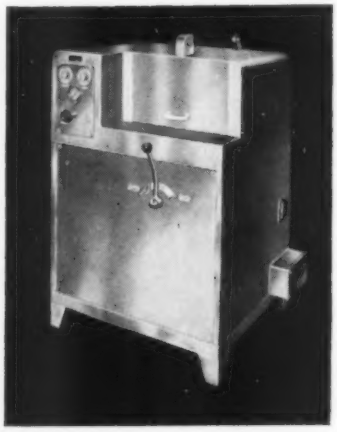

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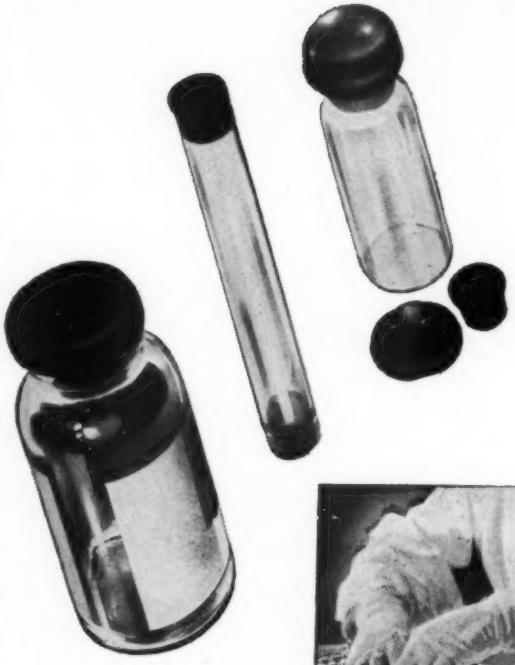

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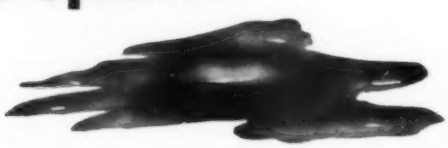

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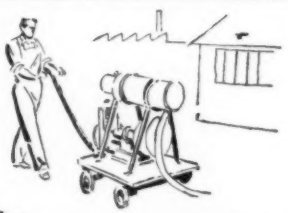

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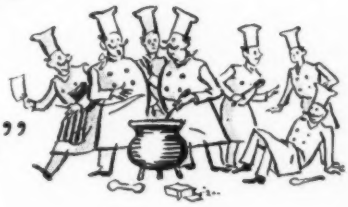
"Too many cooks spoil the broth" 

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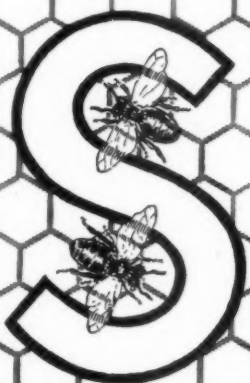

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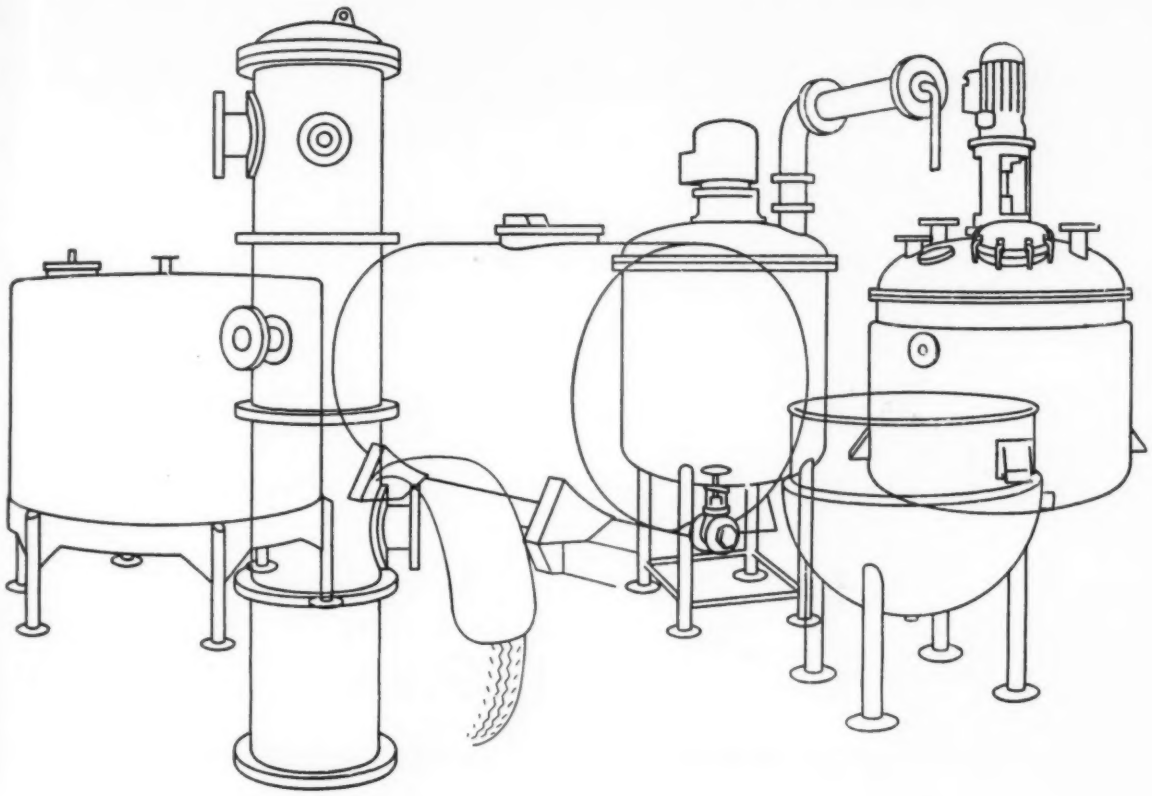

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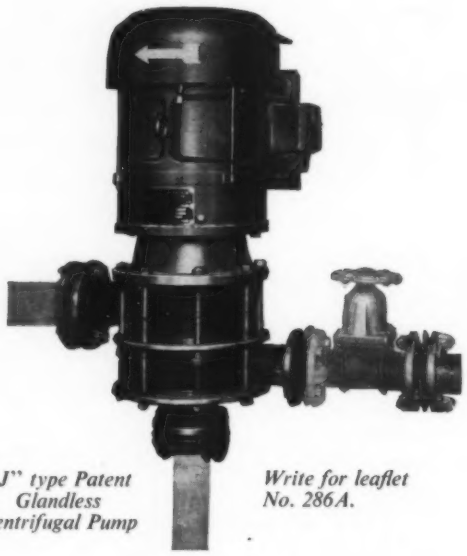

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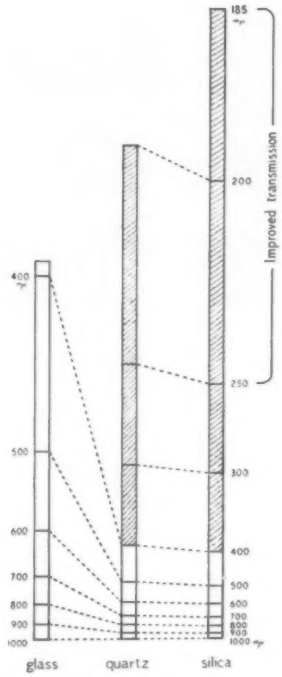

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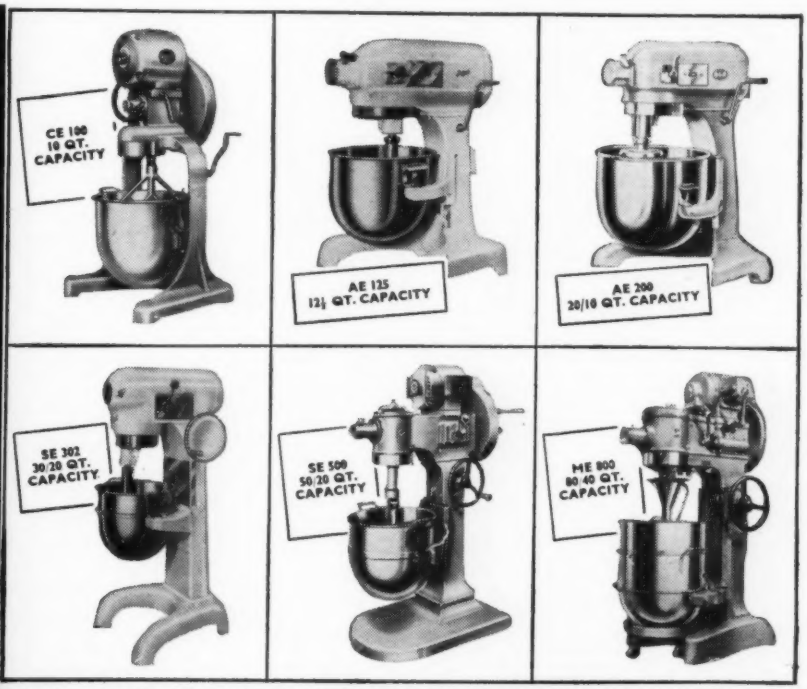

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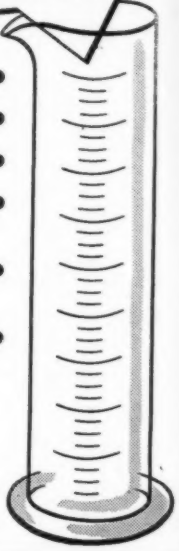

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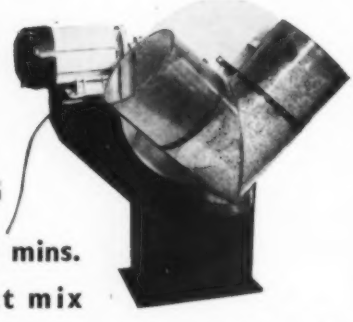

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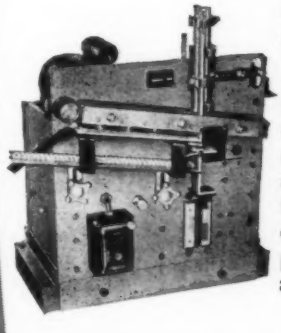

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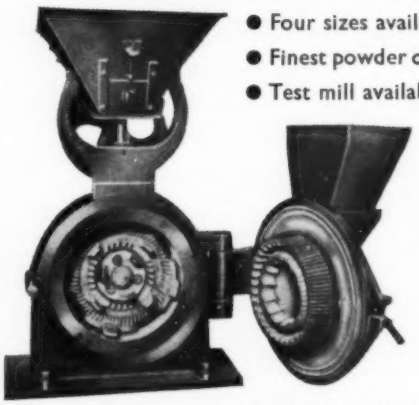

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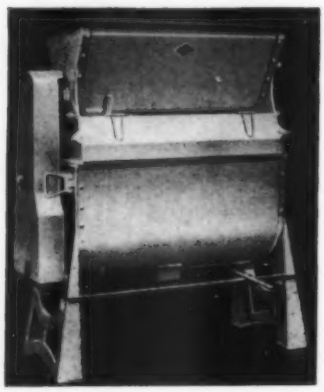

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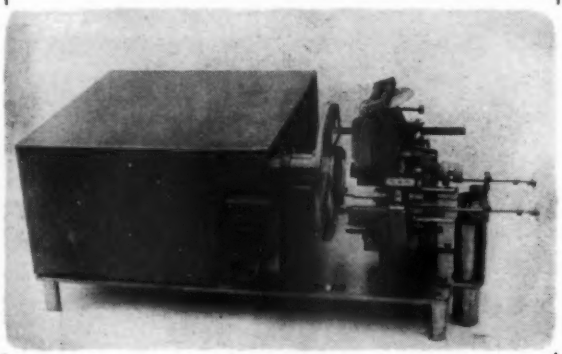

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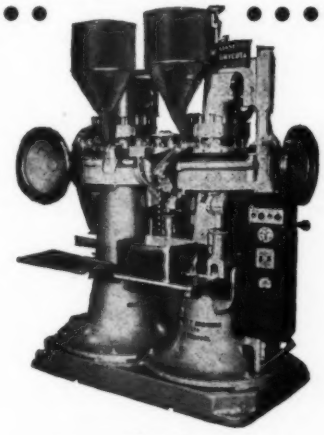

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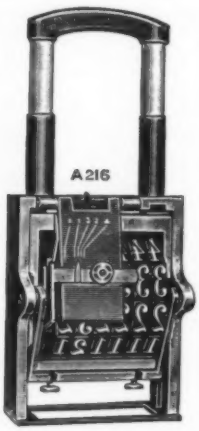

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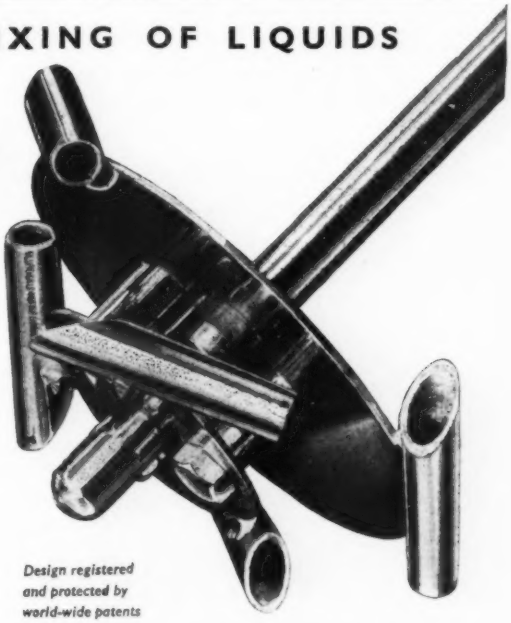

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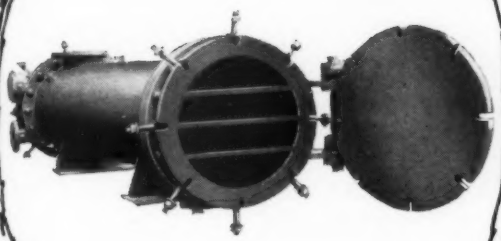

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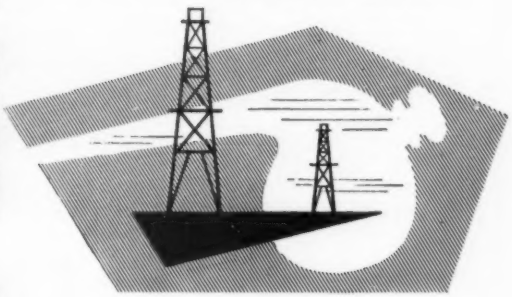

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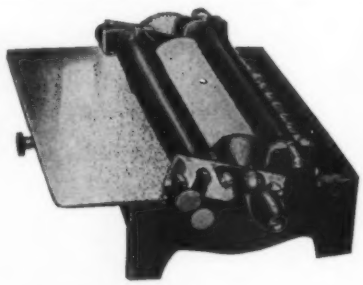

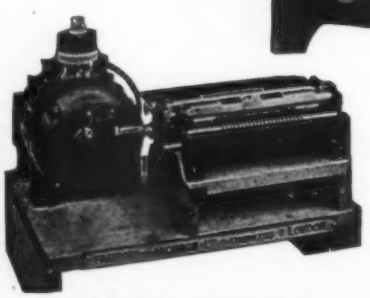

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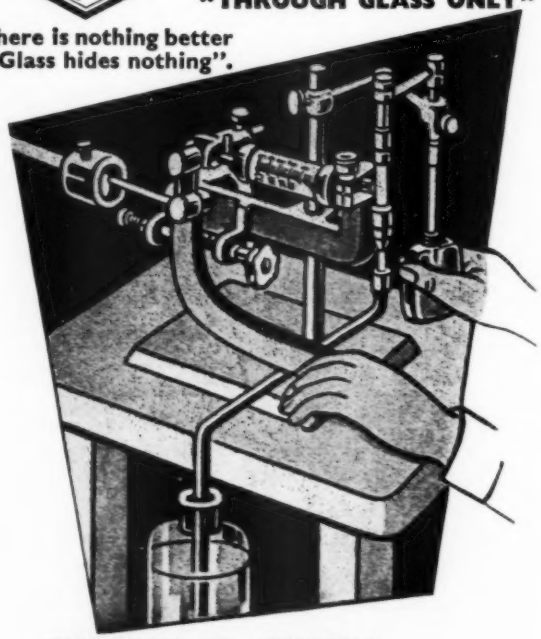

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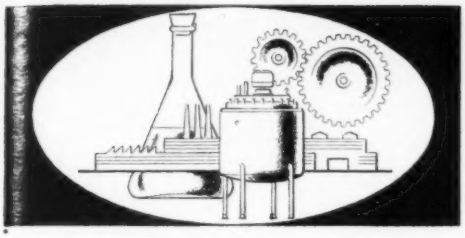

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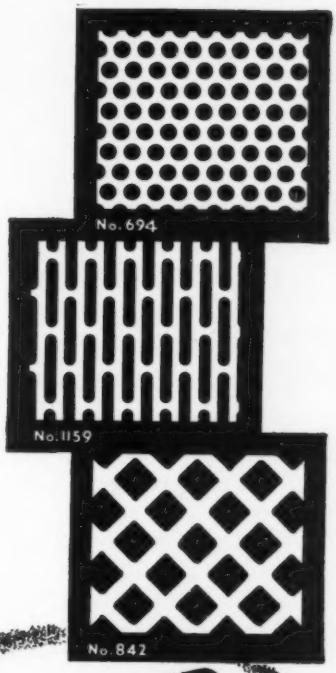

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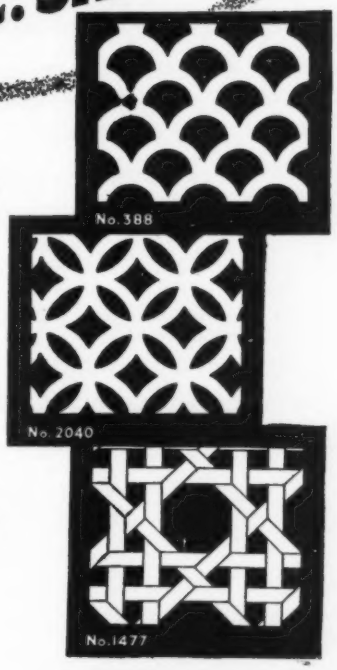

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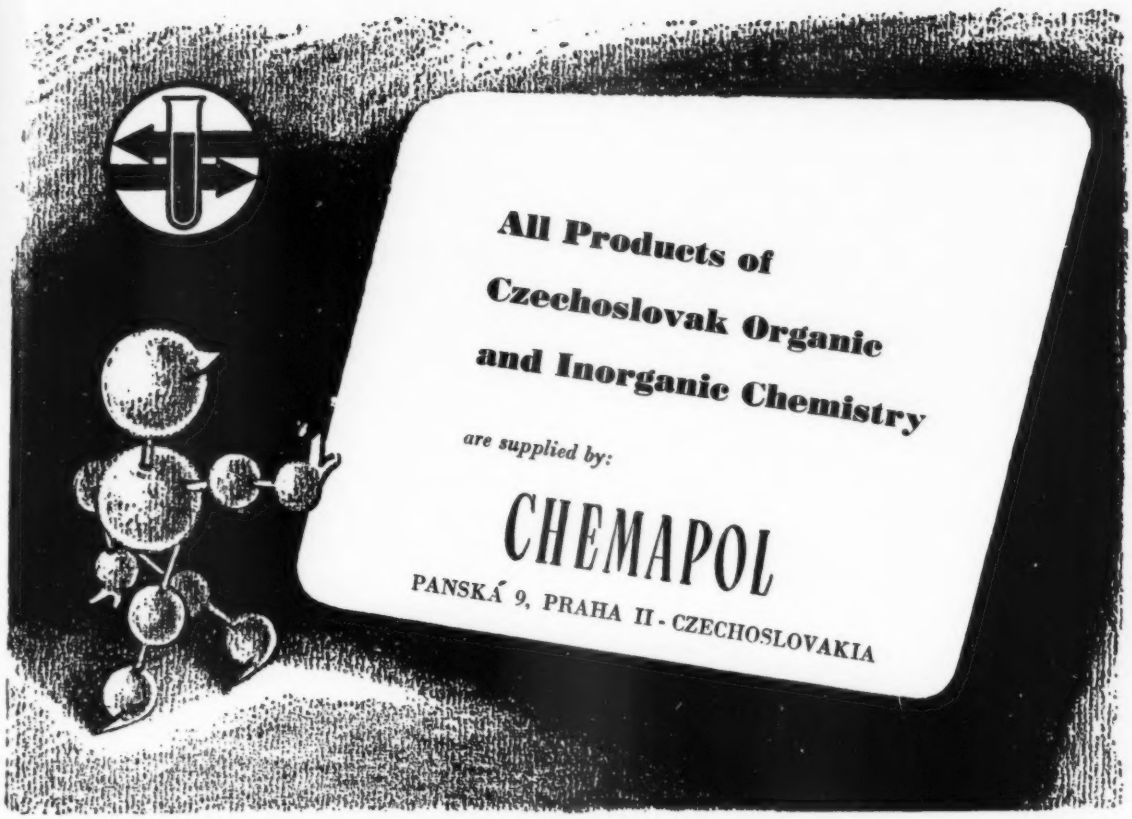

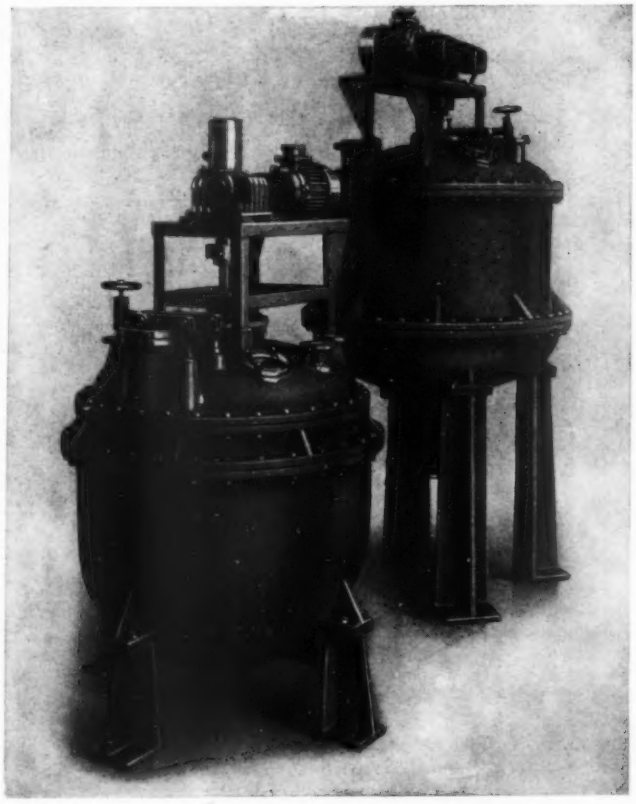

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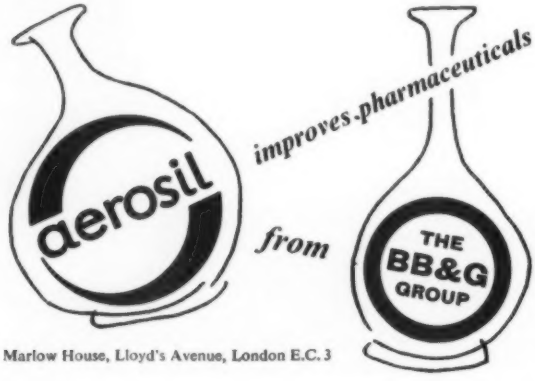

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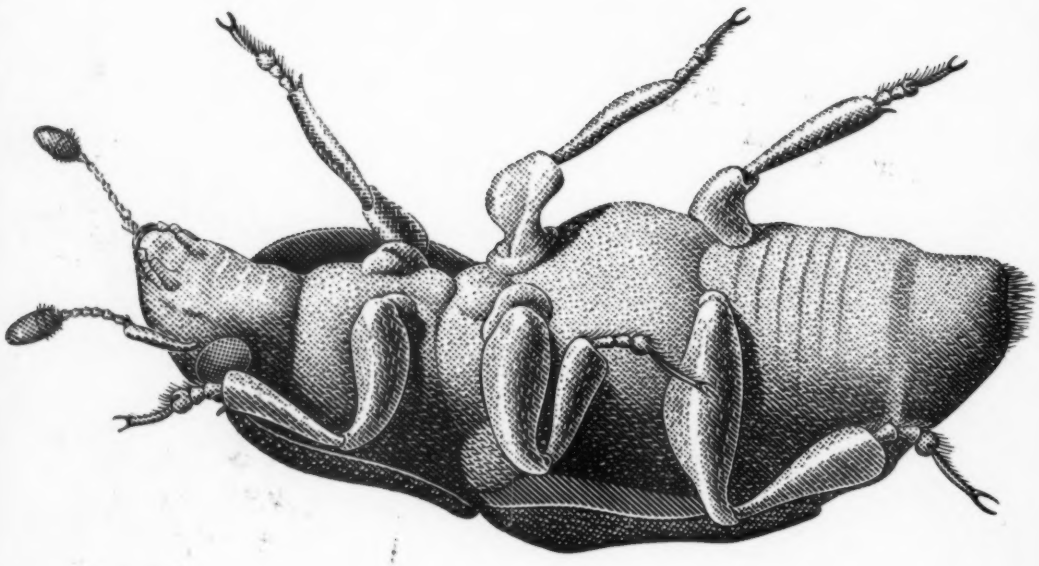

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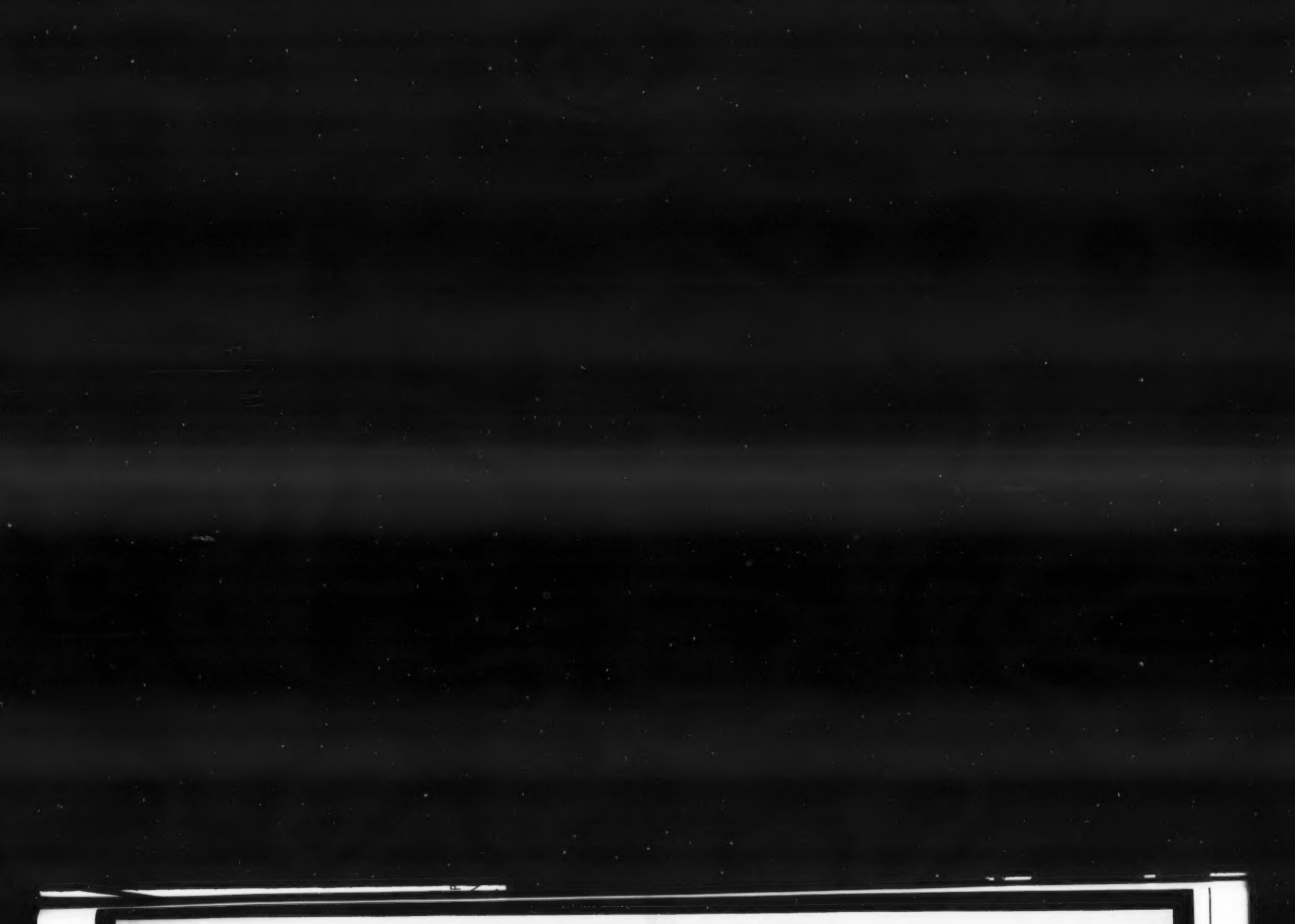
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